Engineering Library

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLVII.—No. 3808] LONDON: FRIDAY EVENING, JANUARY 4, 1929 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

PROGRESS OF THE

ENGINEERING, SHIPBUILDING,

AERONAUTICAL

and

TRANSPORT INDUSTRIES

in 1928.

INDEX TO ADVERTISEMENTS, PAGE 97.

PUBLIC NOTICES

Army Contracts.

Notice is hereby given that TENDERS for quantities of the undermentioned MANUFACTURED GOODS are INVITED from time to time as required :—

METAL TRADES.

Aluminium Ingot, Brass, Brass Rod and Sheet, Bronze Stampings, Copper Ingot and Sheet, Lead, Pig and Sheet, Metal Rod, Nickel, Pig Iron, Steel Plate, Rounds, Sheets, &c., Shell Steel, Tin Ingot, Tin-plates, Zinc Ingot and Sheets.

Baths, Bicycles, Building Materials and Fitments, Cutlery (including Safety Razors and Blades), Enamelled Ware, Hollow-ware, Horseshoes, Ironmongery, Machinery, Pipes, Steel and Cast Iron, Stable Fitments, Stoves and Ovens, Sanitary Appliances, Tinware, Tools, Vehicles, Wire.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES.

Cables, Electrical Plant, Electrical and Wireless Stores, Scientific Instruments.

TEXTILE TRADES.

Blankets and Rugs, Braid and Lace, Canvas and Canvas Goods, Clothing (made up from Department's own materials), Cotton Piece Goods and Cotton Goods, Cordage, Flannel, Headdresses, Horse Rugs, Hosiery, Linen Piece Goods, Silk Cloth and Webbing and Sewing Silk, Towels, Woollen Cloths.

FOODSTUFFS, COAL AND COKE.

MISCELLANEOUS TRADES.

Badges and Buttons, Basket Ware, Bedding, Boots and Shoes, Brooms and Brushes, Chemicals and Gases, China and Earthenware, Furniture, Harness and Saddlery, Leather and Leather Goods, Linoleum, Medical Supplies, Oils and Spirits, Paints and Varnishes, Rubber Boots and Clothing, Timber, Woodware.

Manufacturers who are not already on the War Office List of Tenderers, and who may wish to be invited to Tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the Lists of Tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on 16th February, 1926 :—

"That in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

SALES.—From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned Machinery, Steel Girder Bridges, Scrap Metals, Hutting, Motor Vehicles, Drugs, Medical and Dental Stores, Veterinary Stores, Optical and Scientific Instruments, Electrical and Wireless Stores, Laboratory Apparatus, Clothing, Boots, Textile Goods, Paint. Firms who wish to be invited to Tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing and should be addressed to the DIRECTOR OF ARMY CONTRACTS, Caxton House (West), Tothill-street, Westminster, London, S.W. 1. No application is necessary from firms whose names are already on the War Office Lists, unless they have extended the range of their manufactures.

FRANCIS OSBORN,
Director of Army Contracts.
567

HEATING.

The Commissioners of

His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 23rd January, 1929, for ACCELERATED LOW-PRESSURE HOT WATER HEATING at the Telephone Exchange, Norbury, S.W.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms of Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions.
582

The Director - General,

India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—STEEL TROUGH SLEEPERS.
SCHEDULE 2.—CAST IRON SLEEPER PLATES and DISTANCE PIECES.
SCHEDULE 3.—MILD STEEL GIBS, COTTERS and KEYS for TIEBARS.
SCHEDULE 4.—MILD STEEL TIEBARS.
SCHEDULE 5.—STEEL KEYS for SLEEPERS.
SCHEDULE 6.—46 LOCOMOTIVE BOILERS with CYLINDERS and other EQUIPMENT.

Tenders due as follows :—
Schedules 1 to 5, 30th January, 1929.
Schedule 6, 1st February, 1929.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each schedule.
614

Air Ministry.

DIRECTORATE OF SCIENTIFIC RESEARCH.

A JUNIOR SCIENTIFIC OFFICER is REQUIRED for the Air Ministry Scientific Research Staff, primarily for duty at the Royal Aircraft Establishment, for research in applied physics, chiefly in connection with aeronautical instruments.

Candidates should have a first-class Honours Degree in Natural Science or Mechanical Science, and must be medically fit for flying duties and be willing to fly as observer.

Salary £175 plus Civil Service bonus per annum, giving a present total starting remuneration of £259 9s. per annum on the scale £175-£15-£235 plus bonus per annum.

The appointment will carry superannuation under the Federated Universities Superannuation Scheme, Government contribution being 10 per cent. of salary, individual contribution 5 per cent.

Preference given, other things being equal, to an ex-Service man.

Application should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned, quoting reference No. A.308, not later than 26th January, 1929. 546

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following posts :—

M/1133.—ASSISTANT ENGINEER REQUIRED by the Railway Department of the FEDERATED MALAY STATES GOVERNMENT for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month, and thereafter, in the event of the officer being retained, rising to 500 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. If at the end of four years' service the officer's services have been continuously satisfactory and he does not remain in the service, he will be paid a bonus of 2850 dollars. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferably at a University or a College recognised by the Institution of Civil Engineers and possess a Civil Engineering Degree, or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or completed their articles with a Civil Engineer of good standing and have passed the Examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance, including Bridge Design and Erection on a British Railway.

M/732.—CIVIL ENGINEER REQUIRED by the GOVERNMENT of CEYLON for appointment as Irrigation Engineer for three years' service and prospect of permanency. Salary £500, rising to £900 a year by annual increments of £40 (£600 a year on attaining 30 years of age). Free quarters and free passages provided. Candidates, unmarried, 26 to 31 years of age, must have passed examination to qualify for Associate Membership of the Institution of Civil Engineers or hold professional qualifications recognised by the Institution as exempting from Parts A and B of that examination, and have had at least three years' practical experience on Waterworks, Drainage or Harbour and Dock Works.

Apply at once by letter, stating age and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made.
605

Gold Coast.

A PRINCIPAL is REQUIRED for the Government Technical School, Accra, Gold Coast. Candidates should be University graduates in Engineering or should possess some similar recognised technical qualification, and should be not more than 35 years of age. Salary at the rate of £960 per annum with a duty allowance of £96 per annum, payable whilst the Principal is on duty in the Colony. Free first-class passage and free quarters provided.—Further information may be obtained on application to C.A. (D), the SECRETARY, Board of Education, Whitehall, London, S.W. 1. Scottish candidates should apply to (D), the SECRETARY, Scottish Education Department, Whitehall, London, S.W. 1. The list of applications will close on 28th January. 583

Wanted for the Indian ORDNANCE FACTORIES, GUN AND SHELL FACTORY, COSSIPORE (NEAR CALCUTTA).

An ASSISTANT WORKS MANAGER.

Salary Rupees 550 a month plus £25 a month sterling overseas pay, rising by annual increments of Rs. 50 a month to Rs. 750 plus £25. The appointment is non-pensionable, but there is a Provident Fund subscription to which is compulsory. Free passage to India is granted and quarters, if available, are provided at a rental not exceeding 10 per cent. of salary. An agreement for five years will be entered into in the first instance.

Candidates must have been well educated and must either possess a University Degree in Engineering or have passed the A.M.I.C.E. Examination or have obtained some other corresponding qualification in engineering. In addition, candidates must have had at least 5 years' practical experience with a firm of repute (preferably in an armament workshop), during which period they must have had experience in the drawing-office, in estimating, and in handling and controlling labour.

Candidates must have attained the age of 24 and preference will be given to suitably qualified candidates whose age does not exceed 40 years.

The selected officer will be required to proceed to India early in March, 1929.

Applications should be submitted as soon as possible before the 15th January, 1929, on forms to be obtained from the SECRETARY, Military Department, India Office, S.W. 1. Envelopes should be marked "Ordnance Recruitment."

Applications from candidates who do not possess the requisite qualifications cannot be considered. 518

Crystal Palace School of PRACTICAL ENGINEERING.

PRESIDENT : J. W. WILSON, M.I.C.E., M.I.M.E., F.S.E.
PRINCIPAL : MAURICE WILSON, M.I.C.E., F.S.E.
VICE-PRINCIPAL : F. C. P. LAWRENCE, M.S.E., A.M.I. Struct. E.

EASTER TERM COMMENCES WEDNESDAY, JANUARY 9th. 561

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 23rd January, TENDERS for the SUPPLY of :—
(1) 400-kW HEAVY OIL ENGINE-DRIVEN GENERATING SET.
(2) ENGINE TURNTABLES (85ft. diameter),
and up to Noon on Wednesday, 16th January, TENDERS for the SUPPLY of :—
(3) METALS.
(4) STEEL MATERIAL (Plates, Flats, Angles, Rounds, &c.).
(5) PIG IRON (West Coast Hematite).
(6) TYRES for LOCOMOTIVES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for Nos. 1, 2 and 4, and 10s. each for Nos. 2, 5 and 6 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
31st December, 1928. 547

PUBLIC NOTICES

Bengal-Nagpur Railway Com- PANY, LIMITED.

The Directors are prepared to receive TENDERS for :
A.—STEEL ROUNDS and SQUARES.
B.—6845 STEEL BOILER TUBES.
C.—STEEL CARRIAGE and WAGON AXLES.
D.—3024 LAMINATED BEARING SPRINGS.
E.—GRADE "A" IRON.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 31st December, 1928.

A fee of 10s. will be charged for each copy of the specification, which is not returnable.

Tenders must be submitted not later than Noon on Wednesday, 9th January, 1929, for Specifications A, B and C, and not later than Noon on Thursday, 10th January, 1929, for Specifications D and E.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
E. C. VOLKERS,
560 Secretary.

Metropolitan Water Board.

TENDERS FOR SUPPLY OF PHOTO PRINTS, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of PHOTO PRINTS, &c., to their Head Office for the period of twelve months commencing 1st April, 1929.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after Monday, 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope. Samples of the paper required can be seen at the offices of the Board (Room 201).

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Photo Prints, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 6th February, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
1st January, 1929. 601

Metropolitan Water Board.

TENDERS FOR PIPE LAYING, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern and Western Districts, for the period of twelve months commencing 1st April, 1929.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on and after 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Pipe Laying, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 6th February, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
1st January, 1929. 602

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF CAST IRON PIPES, SLUICE VALVES AND HYDRANTS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for periods of 6 and 12 months, commencing 1st April, 1929 :—

Tender No.
3. Cast Iron Straight and Irregular Pipes.
21. Sluice Valves and Spindles, Fire Hydrants, &c.

Tenders must be submitted on the official forms, which may be obtained from the Chief Engineer on or after Monday, 7th January, 1929, by personal application at the offices of the Board (Room 156) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board not later than 11 a.m. on Wednesday, 6th February, 1929.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
1st January, 1929. 603

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 96.
BUSINESSES and PREMISES (For Sale, etc.). Page 96.
MACHINERY, &c., WANTED, Page 96.
EDUCATIONAL, Page 2.
PATENTS, Page 4.
MISCELLANEOUS, Page 4.
AGENCIES, Page 2.
FOR SALE, Pages 4 and 96.
WORK WANTED, Page 3.
FOR HIRE, Page 2.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Port of Bristol Authority.

CONSTRUCTION OF EASTERN ARM, ROYAL EDWARD DOCK, AVONMOUTH.
DUST REMOVAL PLANT.

The Port of Bristol Authority is prepared to receive TENDERS for the SUPPLY and INSTALLATION of DUST REMOVAL PLANT in connection with the Grain Handling Machinery on the Eastern Arm Extension of the Royal Edward Dock, Avonmouth.

On and after Tuesday, the 1st day of January, 1929, copies of the specification and contract drawing can be obtained from the undersigned on production of a receipt showing that a deposit of £2 has been paid. All cheques must be made payable to "The Port of Bristol Authority," and be forwarded to the General Manager, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide Tenderers after the receipt of a Tender with all the prescribed documents.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Dust Removal Plant," addressed to the General Manager of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him before 10 a.m. on Monday, the 21st day of January, 1929.

The Port Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.

Chief Engineer's Office,
Avonmouth Docks, Bristol,
28th December, 1928. 522

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. ROLLED STEEL DISC WHEELS and AXLES (140 pairs).
2. WATER CRANES (Five).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Rolled Steel Disc Wheels and Axles," or as the case may be, with the name of the firm Tendering, must be left with the undersigned not later than 12 Noon on Friday, the 18th January, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, and of 5s. for each copy of Specification No. 2.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1,
2nd January, 1929. 615

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for :—

9 LOCOMOTIVE BOILERS, "V's" Class, SUPERHEATED (BROAD GAUGE).

Tenders are due in on Tuesday, 29th January, 1929, by 2 p.m.

Tender form obtainable at address below ; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 599

Bristol Corporation Electricity

DEPARTMENT.
APPOINTMENT OF STATION SUPERINTENDENT.

The Electrical Committee of the City of Bristol invite APPLICATIONS for the APPOINTMENT of STATION SUPERINTENDENT at their newly erected Generating Station at PORTISHEAD, near Bristol.

Applicants must have had similar experience in a large generating station.

As it is expected that the station will develop rapidly, the commencing salary will be up-graded to accord with the National Joint Board Schedule for the Electricity Supply Industry, Class J, Grade 3, which at the present cost-of-living figure is £672 3s. 2d. per annum. The appointment will be made subject to the provisions of the Local Government and Other Officers Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination.

Forms upon which applications are to be made can be obtained from the undersigned, which, accompanied by copies of at least three testimonials, must be received not later than Monday, 14th January, 1929, endorsed "Station Superintendent."

H. FARADAY PROCTOR,
M.I.C.E., M. Inst. E.E.,
Chief Engineer and General Manager.

Electricity Department,
Colston-avenue, Bristol. 591

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, a CIVIL ENGINEER for London District, used to the design and carrying out of work in Reinforced Concrete. Capable of handling labour and impressing clients. Age 35-40. Member or Associate Member of Institution of Civil Engineers. Public school. Medically sound. Permanent appointment and good salary with increments to suitable man. —Address application, with copies of testimonials, P5333, The Engineer Office. P5333 A

BRIDGE AND ROOF CO. (INDIA), LIMITED.

WANTED, by the above, for Calcutta, a GENERAL MANAGER. Must be a first-class designer with up-to-date knowledge of Bridgework practice and with actual Works experience. Commencing salary the equivalent of £1800 per annum plus a commission on profits, with excellent prospects for the right type of man. Age about 35.—Apply, with full particulars of career, and photograph if possible, to the COMPANY, c.o. Messrs. Alex. Lawrie and Co., Ltd., 14, St. Mary Axe, London, E.C. 3. 612 A

WANTED, ENGINEER MANAGER for Small Water Co., to Supervise Plant and Rate Collection and Order Stores.—Apply, SECRETARY, Heathfield and District Water Co., Heathfield, Sussex, stating experience and salary. 600 A

ENGLISH FIRMS DESIRING First-class Energetic REPRESENTATION in Australia in engineering and associated lines, can procure same with firm of undoubted standing in Sydney. Excellent financial and selling record.—Write in first instance to Z.H. 251, care Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 584 A

HEATING ENGINEER.—REQUIRED, Competent MAN to take charge of Heating Department. Must be experienced in all types of heating. Able to control staff and workmen. Good personality and energetic. Applicants must be able to act without supervision if necessary. Location—North of England. —Address, in confidence, stating salary, age, and experience, to 610, The Engineer Office. 610 A

REQUIRED, Young Unmarried ASSISTANT, With practical knowledge of Permanent Way, for service in India with Company supplying Permanent Way Appliances. Good education and address essential.—Address, with full particulars, to P5343, The Engineer Office. P5343 A

REQUIRED for London Office, DESIGNER and ESTIMATOR, Light Steel Constructional Work. Must have first-class references. Permanency for the right man. State age, salary, and experience.—Address, P5332, The Engineer Office. P5332 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after Illness.

The Hospital is intended for the children of Members of the Institution of Civil Engineers, the children of architects, artists, authors, clergymen, members of the medical, legal, and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the Merchant Navy, schoolmasters and university professors.

Accommodation is provided for 50 Boys between the ages of 4 and 12 years, and 50 Girls between the ages of 4 and 14 years. In special cases the age limits may be raised to 14 for Boys, and 16 for Girls.

Fee 21/- per week, or as may be arranged, and travelling expenses.

Particulars can be obtained from the Secretary :—

116, Victoria Street, Westminster, LONDON, S. W. 1.

SITUATIONS OPEN (continued)

RESEARCH ASSISTANT WANTED in the Metallurgical Research Dept. of a large industrial firm near London, for work in connection with an experimental rolling mill and wire-drawing plant. A knowledge of Metallurgical Chemistry and Metallography is desirable ; some works experience is preferred, but is not essential. Send full details of age, education, experience, and salary required before January 12th.—Address, 572, The Engineer Office. 572 A

SMART JUNIOR REQUIRED, Age Between 20 and 24. Must have had previous drawing-office or estimating experience.—Address, 557, The Engineer Office. 557 A

TRAVELLER for SPRINGS REQUIRED, with Connection. Salary and commission.—HOMMADE, Ltd., Enfield-road, Acton, W. 3. 548 A

TRAVELLER REQUIRED ; Sound Technical knowledge and good salesmanship record, Air Compressors (portable and stationary) and Pneumatic Tools. Commission, expenses and salary ; permanency for the right man.—Address, 573, The Engineer Office. 573 A

WANTED, First-class DRAUGHTSMAN, Accustomed to Chemical Plants, Lay-outs and details. Man familiar with Solvent Recovery and Coke-oven Products preferred. State age, salary required, and when at liberty.—Address, 525, The Engineer Office. 525 A

WANTED IMMEDIATELY, DRAUGHTSMAN, accustomed to the design and detail of Suspended Furnace Arches and Combustion Chambers, London District.—Address, P5335, The Engineer Office. P5335 A

WANTED, JIG and TOOL DRAUGHTSMAN, with knowledge of Machine Design. State age, experience, and salary required.—Address, 588, The Engineer Office. 588 A

A Good JUNIOR DRAUGHTSMAN for Mechanical Detailing of Medium-sized and Special Electric Motors ; also one with experience in Control Gear.—Apply, stating age, experience, and salary required, to LAURENCE, SCOTT and Co., Ltd. Norwich. 606 A

CENTRIFUGAL PUMP DRAUGHTSMAN, Capable Designer and Accurate Detailer of efficient pumps at competitive prices. Good job for the right man. Experience and previous employers, together with salary required, to be stated. Juniors not eligible.—Address, 608, The Engineer Office. 608 A

CHIEF DRAUGHTSMAN for Tool Room and Relieving Lathes ; only one who has real knowledge of these machines is required.

Good conditions and good salary are offered for this job in London.

Address, 524, The Engineer Office. 524 A

DESIGNING ENGINEER WANTED. Experience bucket elevator, concrete plant. Sound practical draughtsman. Write, stating age, experience and salary required. P5340, The Engineer Office. P5340 A

DRAUGHTSMAN REQUIRED, Accustomed to Producing scheme drawings and projects for Conveyors and Mechanical Handling Plants. Only men capable and used to working on their own initiative will be considered. State age, wages, and experience.—Address, 597, The Engineer Office. 597 A

DESIGNERS REQUIRED for Leading Firm of Long-distance 'Bus and Commercial Vehicle Manufacturers in London District. Only fully qualified and experienced men need apply. Good salary for right men.—Address in confidence, stating age, experience, salary required, to 514, The Engineer Office. 514 A

DRAUGHTSMAN (for Midlands). Experienced in Design of Vertical Four-cycle Cold-starting Heavy Oil Engines. State age, experience, and salary required.—Address, P5337, The Engineer Office. P5337 A

DRAUGHTSMAN REQUIRED in the North ; Must have had experience in Designing Propellers.—Address, stating age, qualifications, salary required, married or single, to P5339, The Engineer Office. P5339 A

DRAUGHTSMAN REQD., N. Borneo. Power Plant and Mechanical experience. Age 30-35, Sal. £6/700 p.a.— Call LESLIE and CO., Employment Specialists, Empire House, St. Martins-le-Grand, E.C. 1. No preliminary fee. 616 A

DRAUGHTSMAN REQUIRED by London Firm, capable of preparing Plenum Heating and Ventilation Schemes under supervision ; also DRAUGHTSMAN, experienced in Dust, Chip and Shaving Removal. —Write, stating experience, salary required, and age, to Box 93, c/o Mather and Crowther, Ltd., 10/13, New Bridge-street, E.C. 4. 549 A

DRAUGHTSMEN (TWO) REQUIRED in London Constructional Engineer's Office.—Address, giving full experience, age, and salary required, P5334, The Engineer Office. P5334 A

DRAUGHTSMEN WANTED with First-class Experience in Estimating and Design of Conveying plants. Must be fully qualified in design of light structures.—Write, stating age, experience, salary required, and when free, to Messrs. STOTHERT and PITT, Ltd., Engineers, Bath. 521 A

DRAUGHTSMAN, with Good General Engineering knowledge, REQUIRED for Factory in London area.—Apply, stating age, experience, and salary required, to Z.R. 258, care Deacon's, Fenchurch-avenue, E.C. 3. 598 A

DRAUGHTSMAN, With Good Experience in Designing Quarry Machinery, Stonebreakers, Granulators, Concrete Mixers, &c., REQUIRED by Leicester firm.—Address, fully stating experience, salary required, etc. to 609, The Engineer Office. 609 A

ENGINEERING DRAUGHTSMAN WANTED in South England.—Address, with particulars of age, experience, and wages required, 596, The Engineer Office. 596 A

SITUATIONS OPEN (continued)

EXPERIENCED STRUCTURAL DRAUGHTSMAN REQUIRED for Calcutta. Age 26-28, single.—Write, with full particulars, to Box 389, Leathwait and Simmons, 34, Throgmorton-street, E.C. 2. P5323 A

EXPERIENCED MECHANICAL DRAUGHTSMAN, accustomed to Internal Combustion Engines. Shop experience essential. State age, experience, and salary required.—Write, Box 44, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 551 A

FIRST-CLASS DESIGNER, MECHANICAL, REQUIRED, London district. State fully qualifications, experience, age, salary required.—Address, P5330, The Engineer Office. P5330 A

IMPORTANT MANUFACTURING FIRM, Dealing with Hydraulic Turbines and Hydraulic Equipment, REQUIRE HYDRAULIC ENGINEERING DRAUGHTSMEN. Preference will be given to those with experience in design and tender work. Will engineers with suitable training apply, giving full particulars of their qualifications and salary required. —Address, 570, The Engineer Office. 570 A

JIG and TOOL DESIGNER REQUIRED in Works situated about 30 miles south of London. Only those who have had experience on Automatic Machinery and similar work need apply.—Address, stating age, experience, and salary required, 592, The Engineer Office. 592 A

JUNIOR MECHANICAL DRAUGHTSMAN for London District. Works and D.O. experience desirable, with some knowledge light structural steel and bunker work.—Address, P5344, The Engineer Office. P5344 A

JUNIOR DRAUGHTSMAN REQUIRED for Tracing and Detailing Work.

ALSO

SENIOR DRAUGHTSMAN, with Drawing Office and Shop experience and technical knowledge, accustomed to limiting small interchangeable repetition work.—Apply by post in the first instance, giving age, training, experience, salary required, and date available, to ALLEN-LIVERSIDGE, Ltd., Research Dept., 175A, Manor-street, Clapham. 613 A

MECHANICAL DRAUGHTSMAN, with General experience, age 30-35, for large Manufacturing Works, Manchester district.—Address, 587, The Engineer Office. 587 A

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester, REQUIRE a DESIGNING DRAUGHTSMAN for Switchgear. Must be neat, quick and accurate, and have had experience in the designing of Switchgear for all voltages.—State training, experience, and salary required.—Apply by letter, addressed to the COMPANY'S EMPLOYMENT DEPARTMENT, marked "Switchgear Draughtsman." 564 A

STRUCTURAL DRAUGHTSMAN REQUIRED ; must be thoroughly competent and up-to-date. Give age and full particulars of experience with salary required.—Address, 552, The Engineer Office. 552 A

TEMPORARY DRAUGHTSMAN WANTED IMMEDIATELY. Experience in detail work design on Air Compressors essential. Salary £4 10s. per week. —Address, stating age, experience, &c., 489, The Engineer Office. 489 A

TWO First-class LEADING DRAUGHTSMEN REQUIRED by Firm of Water-tube Boilermakers in London. Applicants must possess sound experience in this class of work.—Address in first instance, stating age, qualifications and salary required, 563, The Engineer Office. 563 A

TOOL DESIGNER REQUIRED. Shop Experience essential. Knowledge of Small Arms desirable.—State age, experience and salary required.—Write, Box 43, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 550 A

ASSISTANT FOREMAN WANTED in South of England, to Take Charge of Small Department producing interchangeable light parts to the finest limits of accuracy. Only men who can show they have experience in charge of high-class machinery need apply. State age and give full particulars of experience and where gained.—Write, Box 175, Sells Advertising Offices, Fleet-street, E.C. 4. 586 A

FOREMAN for Press Department ; Must be a capable man, accustomed to controlling large department on mass production. Only expert men need apply, stating experience, present position, and salary required.—Address, 558, The Engineer Office. 558 A

MACHINE SHOP FOREMAN REQUIRED, Used to Switchgear and Radio Work. Must have good experience in production in small quantities of special details combined with sound knowledge of mass production methods.—Write, stating experience, age, salary required, to Box 152, Sells, Fleet-street, E.C. 4. 562 A

INDIA.—REQUIRED, Capable MACHINE SHOP FOREMAN, with experience in all classes of machinery, also erection and repairs of machines and repetition work in the machine shop on a large scale. Age 26-30 and single.—Write, with full particulars of experience and copies of testimonials, to Z.R. 236, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 585 A

SITUATIONS WANTED

INSPECTION OR PRODUCTION.

ADVERTISER (26), Secondary School Education, single, DESIRES POST of Chief, Assistant Chief or Tool Inspector or Production Engineer. Eleven years' practical experience, technical training and D.O. Similar positions held with two leading engineering firms. Wide experience in tool design, works organisation and layout for efficient production of electrical and mechanical goods. Good references ; services available immediately.—Address, P5309, The Engineer Office. P5309 B

SITUATIONS WANTED (continued)

COMMERCIAL ENGINEER, with Sound Experience in buying and selling, estimating, &c., importing and home trade, accustomed to managerial duties, SEEKS CHANGE with prospects.—Address, P5329, The Engineer Office. P5329 B

ENGINEER and FUEL TECH. M.I.F., at Present holding executive position, is DESIROUS of a CHANGE.

Good organiser and strict disciplinarian. Wide experience in the design and application of PULV. FUEL TO W.T. AND LANCASHIRE BOILERS, ALSO METALLURGICAL FURNACES.

Address, P5305, The Engineer Office. P5305 B

ENGINEER DISENGAGED, Late Shop Superintendent, chief inspector. Experienced up-to-date production methods and layout on high-class work demanding extreme accuracy ; 12 years' shops production and tools, 9 years executive. First-class refs. Age 36. London district preferred, not essential—Address, P5327, The Engineer Office. P5327 B

ENGINEER, Commercial, Well Educated, Aged 25, SEEKS CHANGE. Technically trained to Inter. B.Sc. standard and has good knowledge of foundry trade. Previously general manager's assistant, now representative.—Address, P5325, The Engineer Office. P5325 B

ENGINEER (25), with Practical, Marine and Commercial experience, REQUIRES APPOINTMENT at home or abroad.—Address, P5322, The Engineer Office. P5322 B

ENGINEER REQUIRES POSITION, Maintenance to Hydraulic Cranes and Machinery. Has had best of experience.—Address, P5341, The Engineer Office. P5341 B

MECH. ENGINEER, B.Sc., Varied Experience shops and D.O., now and for some years with P.W. and building contractor, accustomed quantities, estimating and supervision, DESIRES POST on Plant and Building Staff of large Industrial Concern.—Reply, B., Elliswick Lodge, Harpenden, Herts. P5159 B

MECHANICAL ENGINEER and WORKS SUPERINTENDENT (41), recently returned from South America ; 26 years' railway workshop experience and carriage and wagon design and maintenance at home and abroad, SEEKS RESPONSIBLE POST as WORKS MANAGER. Willing to consider going abroad.—Address, P5338, The Engineer Office. P5338 B

MARINE ENGINE DRAUGHTSMAN and PRACTICAL ENGINEER, aged 35, ex Engnr.-Lieut., R.N., 1st Class B.O.T. Certificate, have sailed "chief engineer" in tankers and other vessels, DESIRES POSITION ashore or afloat, at home or abroad. Genuine worker, excellent references.—Address, P5342, The Engineer Office. P5342 B

PRODUCTION ENGINEER, Chief Draughtsman, 36, sound experience, design, planning, tools, &c., A.M. I Mech. E., London.—Address, P5318, The Engineer Office. P5318 B

TECHNICAL ENGINEER, 9 Years' P.O. and general engineering, 3 years' technical training, some commercial experience, DESIRES RESPONSIBLE POSITION.—Box 7, Willing's, Gray's Inn-road, W.C. 1. 555 B

WORKS MANAGER SEEKS ENGAGEMENT. Technical and practical on boiler tank, smith, and fitting shops ; expert on welding and hydraulic pressings ; good estimator and controller of men. Sound references.—Address, P5331, The Engineer Office. P5331 B

EDUCATIONAL

Correspondence Courses

OF PREPARATION FOR THE

Examinations of the

INST. OF CIVIL ENGINEERS,
INST. OF MECHANICAL ENGRS.,
INST. OF STRUCTURAL ENGRS.,
UNIVERSITY OF LONDON, &c.,
are personally conducted by

Mr. Trevor W. Phillips,

B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.

For full particulars and advice apply to :—8-11, TRAFFORD CHAMBERS, 58, SOUTH JOHN ST., LIVERPOOL (Tel., Bank 1118). LONDON OFFICE :—65, CHANCERY LANE, W.C. 2. Ex

AGENCIES

FORGINGS of Any Kind, PARTS of WAGONS, TOOLS and ENGINES, raw and finished, according to sample or design, made by economical process on up-to-date machines. Sockets and flanges.—WESTWERK GELSENKIRCHEN, Germany. Well-introduced REPRESENTATIVES WANTED. 594 D

REPRESENTATIVE for the Sale of Non-ferrous Castings is REQUIRED for the London area. One who has a good connection among engineering and industrial undertakings and has other agencies for this class of consumer, which could be worked in conjunction.

All applications would be treated in confidence. C. and L. HILL, Ltd., Sandbeds Foundries, Willenhall, Staffs. P5328 D

REPRESENTATIVE, Good Address (with Car), regularly covering leading towns Eastern and South-Eastern Counties (outside a 20 miles' radius of Charing Cross) for well-known makers small engineering lines, calling on engineers, mill furnishers, hardware factors, ironmongers, &c., REQUIRES ONE or TWO ADDITIONAL LINES on commission basis. —Manufacturers interested please address in first instance, 554, The Engineer Office. 554 D

THOMAS SMITH and SONS (RODLEY), Ltd., Steam and Electric Crane Works, Rodley, Leeds, REQUIRE a DISTRICT REPRESENTATIVE for the North-East Coast to work on a commission basis and preferably having offices situated at Newcastle.—Replies should be addressed to the SECRETARY and give fullest details of experience. 593 D

TO MANUFACTURERS of Products for Power Stations, Mills, &c., requiring REPRESENTATION in the Yorkshire area by Engineer with wide 20 years' experience on steam and oil, prime movers.—Address, P5304, The Engineer Office. P5304 D

FOR HIRE

APPLY TO RICHD. D. BATCHELOR, ARTESIAN WELL & CONSULTING ENGINEER
(WATER SUPPLIES EXPERT)
All equipments for improving your Water Supply
Largest Well Boring Plant, 9in. to 9ft. diam.
Every description of Pumping Plant.
73, Queen Victoria-st., E.C. 4, and Chatham.
'Phones ; Central 4908 ; Chatham 2071.
Wires : Boreholes, London ; Watershed, Chatham.
ESTAB. OVER 150 YEARS.

FOR HIRE, PUMPS and WELL-BORING TOOLS for Trial Borings and Deep Wells.—R. RICHARDS and CO., Upper Ground street, London, S.E. Telephone No. 0978 Hop. 522 E

For continuation of Small Advertisements see page 4.

JANUARY 4, 1929.—VOL. CXLVII.

THE ENGINEER.

A Seven-Day Journal

The Darlington Railway Accident Report.

THE report to the Minister of Transport by Colonel Sir John Pringle on the serious collision of June 27th last at Darlington, wherein twenty-five passengers lost their lives, was issued on Friday, December 28th. The responsibility for the accident is laid on the driver of the parcels train, who, in making a second shunt, passed some signals at "danger," although, when making an earlier and corresponding movement, the corresponding signals were at "clear" for him. As a consequence his train fouled the path of the excursion train and the collision followed. The report will be reviewed at length in a later issue, and it will then be seen that the driver was sadly lacking in his knowledge of the road and signals. He could give no explanation why he treated the signals, for the line on which he was when making the second shunt, in a different way from that in which he acted when making the first movement on the adjoining line where the signalling arrangements were identical. As was only natural the accident has furnished the Ministry with another instance in which automatic train control would have prevented a collision. Nearly the whole of the deaths and most of the injuries occurred in the second coach on the excursion train, which vehicle was telescoped by the one behind it. That fact has led Sir John to make some interesting observations on the possibilities of preventing telescoping, and, what is of greater moment, on some of the possible drawbacks of all-steel coaches.

The Late Sir Charles Metcalfe.

A DISTINGUISHED pioneer in railway engineering in Africa has been removed from among us by the death—in his seventy-sixth year—of Sir Charles Metcalfe, which took place at his home at Winkworth Hill, near Godalming, on December 29th. Charles Herbert Theophilus Metcalfe—to give him his full name—sixth baronet, ably carried on the traditions of a family all the members of which were in their times and ways overseas pioneers. Whereas, however, the lot of his predecessors was, for the most part, cast in India—the first holder of the title having been on the Board of the old East India Company, though later, as Lord Metcalfe, he became Governor-General of Canada—his sphere of action lay in South Africa, and particularly in Rhodesia. After passing through Harrow he proceeded to Oxford, and there he came in touch with the man who undoubtedly gave him his inspiration—Cecil Rhodes. The two became fast friends, and later made many journeys together by light mule wagon through tracks of country which had previously been barely, if at all, traversed by white men. Rhodes it undoubtedly was who dreamed of the railways which would make these regions accessible, but it was Sir Charles, and his firm—Sir Douglas Fox and Partners—who turned many of the dreams into realities. Among the undertakings with which he and his firm were specially concerned were: The line from Kimberley to the Congo, the Beira and Mashonaland Railway, the Victoria Falls Bridge, the Benguella Railway, and many others. Not only could he survey the country for, and construct railways, but he was also possessed of a peculiar aptitude for picking out the best lines from a commercial, or—to put it crudely—paying point of view, that they should take. With Rhodes he may well be named "Empire Builder"; he was of a type which has made the British Empire what it is.

Electrical Contracts.

SEVERAL important electrical contracts have just been awarded to British electrical firms. Two, totalling nearly £500,000, have been given to the Metropolitan-Vickers Electrical Company, one being for two 42,000-kilowatt turbo-generator sets for the Rotterdam municipality and the other for twenty-one electric passenger locomotives for the Great Indian Peninsula Railway. Originally, three trial engines were ordered, two from this country and one from the Continent, and the order which the Metropolitan-Vickers Electrical Company has now secured is the result of the trials that have been carried out. Another contract that has just been obtained by a British firm in the face of severe continental competition is for the manufacture and installation of a telephone trunk line between Alexandria and Cairo. This contract, which represents no less than £193,000, was obtained by the Pirelli General Cable Company, whose works are at Southampton and Eastleigh. Competition for the work came from America, Germany, France and other countries, but the Pirelli scheme was deemed to be the most satisfactory. The cable will be made at the company's Eastleigh works, and its installation will take about eight months.

Extensions at the Port of Calcutta.

ON Friday last, December 28th, the Viceroy of India opened the new King George's Dock at Calcutta. Work on this extensive scheme of dock construction was begun in February, 1920, and the foundation stone of the dock just opened was laid by the Duke of Connaught on the occasion of his visit to India in 1921. It is estimated that the new docks have involved an expenditure of over seven million pounds. They form an independent dock system in the Garden Reach district, to the south of Calcutta, and run north and south, with a basin at the northern river-side end and two arms of nearly 4500ft. in length. A large entry lock gives access to the basin, and alongside the lock are two dry docks, which can be used as a second entrance, if so desired. There is a total quay length of about 25,000ft., which provides for thirty-five berths, and the total water area of the docks is about 190 acres. The entrance lock itself is 90ft. in width with a length of 700ft., and it has a depth of water on the sill which varies from 22ft. at lowest tide water to 56ft. at highest tide water. The two dry docks have a length of 1190ft. and a width of 80ft. and are each capable of being converted into two dry docks with lengths of about 590ft. and 575ft. respectively. The lowest water level on the sill of the dry docks is 23½ft., with a highest water level of 45½ft. Of the total of thirty-five berths, thirty-three are equipped as import or export berths, with modern cargo-handling facilities, and well arranged storage sheds. The two other berths will be employed for waiting steamers and for vessels requiring heavy lifts. Railway lines run alongside the docks, so that goods can be shipped direct into the steamers. The work has been difficult on account of the nature of the silt deposits upon which the docks have had to be built, and the completed task ranks as one of the most important dock engineering undertakings in the world.

The London Terminal Aerodrome.

IN our issue of May 4th, 1928, we recorded the official opening of the reconstructed London Terminal Aerodrome at Croydon, and described in particular the construction of the two new large sheds which had just been completed for the accommodation of the machines using the air port. Each of these sheds covers an area of 300ft. by 150ft., which is divided into two equal portions, measuring 150ft. square. The whole of one shed is at present in use by Imperial Airways, Ltd. Of the other shed, half is reserved for the aircraft of the foreign lines running services to and from Croydon, while the other half is kept for irregular visiting aircraft. During one week last summer there were as many as 113 arrivals and departures of British aircraft and 132 of foreign aircraft at the air port, while even in December the numbers were 31 and 39 respectively in an equal period. The shed accommodation at present available is sufficient for this traffic, but it will probably cease to be so in the not distant future. Looking ahead, the Air Ministry has taken steps to ensure an extension of accommodation when it becomes necessary. The Waddon National Aircraft Factory, erected during the war, adjoins the aerodrome. Since shortly after the Armistice it has been largely in the occupation of the Aircraft Disposal Company, Ltd.—now A.D.C. Aircraft, Ltd.—and has been used by it for the storage of the surplus aeroplanes, aero-engines, and aeronautical stores taken over by the company from the Government. The Air Ministry has now taken over the old erecting shed and fuselage assembly shed of the factory. These sheds have a frontage of 720ft. to the aerodrome, and when required will be brought into use to double the available hangar accommodation at the air port. Until that time arrives, the sheds will be let to A.D.C. Aircraft, Ltd., and the Surrey Flying Services. The rest of the old factory is being disposed of in other ways.

The Railways and Road and Air Transport.

THE railways continue to develop actively the powers granted them by Parliament last year to organise road transport services on their own initiative or in conjunction with established road transport organisations. On the first of the month it was announced that the Great Western Railway and the National Omnibus and Transport Company had entered into an agreement to form a new company, the Western National Omnibus Company, Ltd., with a capital of £1,000,000, which would take over all the passenger road services operated by the two companies in an agreed area in the West of England. The area to be served, it is understood, will consist of the districts south and west of Exeter, excluding those areas already served by the Southern Railway. The Great Western Railway has been operating motor omnibus services in this area since 1903. The National Omnibus and Transport Company has been in existence for about twenty years, and now owns several hundred vehicles. Quite recently, the Great Western Railway directors authorised expenditure on the provision of 209 goods lorries and 122 omnibuses. On the 1st of the month the joint omnibus services in the Sheffield area came into force under the scheme, referred to in our issue of December 7th, 1928, arranged between the Corporation of Sheffield and the L.M.S. and L.N.E.R. railways. The London and North-Eastern has also plans in hand for its own services, as is evidenced by the fact that it has placed an order for twelve 20-seater omnibuses with Guy Motors, Ltd. The Southern Railway does not at present operate any road services, but it is announced that it is making plans and hopes to have certain services in operation during the course of this year. In this connection it is perhaps of some significance that Sir John Thornycroft recently joined the company's board of directors. All this activity of the railway companies on the roads is likely to be coupled shortly with a corresponding interest on their part in transport by air. Bills empowering them to provide air transport are to be introduced in the present session of Parliament. It is claimed that if such powers are granted, the companies will be in a position to co-ordinate all forms of transport to the public advantage, and in a manner that will avoid heavy capital expenditure in the future.

Railway Programmes for 1929.

IT is announced by the London and North-Eastern Railway that it has authorised the construction of 110 new locomotives during the next twelve months. Eight of the new engines will be of the "Flying Scotsman" "Pacific" type of heavy express passenger locomotive, of which the company has already sixty-two in use. Nine "Mogul" 2–6–0 passenger and goods engines, twelve 4–6–0 passenger engines, and twenty-seven 0–6–0 medium goods engines are included in the programme. Twenty-eight tank engines of a new design for service in Scotland and six suburban tank engines will also be built. All these engines will be constructed in the company's own shops. In addition, twenty 0–4–0 shunting engines will be purchased from outside. The London Underground Railways Group has also published particulars of its programme for the year. In addition to the rebuilding and improvement of several stations, 372 new cars are to be put into service on the tubes and 91 new motor cars on the District Railway. Many improvements are also to be carried out at the Lots-road Power Station, including the installation of a sixth 15,000-kW generator set, new boilers, and new switchgear.

Naval Construction in 1928.

IN view of the rather loose talk that is still heard in certain quarters about "competition" or "rivalry" in naval armaments, it seems desirable to place on record one very remarkable fact. At the present moment there is not a single warship exceeding 10,000 tons under construction in any part of the world, nor will any warship above that tonnage be laid down for several years to come. We may say, indeed, that not for fifty years have international naval armaments been restricted to so modest a basis as they are to-day. Capital ship construction is at a complete standstill. Cruisers are being built, it is true, but the total number is by no means large, the maximum displacement is 10,000 tons, and some of the vessels are much smaller than this. Even in the lighter categories, *i.e.*, torpedo craft and submarines, the current world output is far below that of pre-war days. Moreover, the past year has witnessed no extension of building commitments at home or abroad. It is possible that, before these lines are in print, the United States Congress may have passed the Bill authorising fifteen new cruisers; but in view of the American Navy's obvious shortage of modern cruising ships, it would be unfair and irrational to cite this measure as evidence of a competitive spirit in naval armaments. In Great Britain the five-year programme enacted in 1925 has been reduced by no less than three cruisers. French naval construction is proceeding systematically, but it is confined in the main to small craft, the numbers of which are apt to convey an exaggerated impression of French strength at sea. Italy and Japan are both working on replenishment programmes, neither of which, however, is ambitious in scope. Two factors are reponsible for the limited amount of naval shipbuilding now in progress as compared with pre-war times:—First, the absence of any serious cloud on the horizon of international politics; secondly, the heavy cost of modern naval material. Nor must the influence of the Washington Treaty be ignored. Whatever the shortcomings of that covenant may be, it has certainly imposed an effective brake on the multiplication of heavy fighting ships, thereby relieving the financial burdens of the Powers concerned without prejudicing the balance of strength afloat.

Several notable ships of the year are illustrated in one of our Supplements to-day. We have to thank Dr. Oscar Parkes, joint editor of Jane's "Fighting Ships," for the originals from which our blocks were made.

The British Empire.

The most notable event of the year was the completion of our first group of post-Treaty cruisers, as also of the two Australian ships of this class, and the —reconstructed—aircraft carrier "Courageous." Following the delivery of the "Berwick," "Cornwall," and "Cumberland" between September and December, 1927, the "Suffolk" was commissioned in January, 1928, and the "Kent" in the following month. All five ships, designed by Sir E. T. d'Eyncourt, are now serving on the China Station. While this type of 10,000-ton cruiser has been a target for criticism on the score of its vulnerability, it has merits which do something to compensate for this admittedly serious yet unavoidable defect—one that is common, by the way, to all cruisers designed under Treaty rules. The "Kent" and her sisters probably have better sea-keeping qualities than any previous British cruisers. Their steaming radius at economical speed is 10,500 miles. They have a very powerful armament, so mounted as to be capable of effective action in almost any weather; they have been shown to possess a margin of speed considerably over the contract figure of 31·5 knots, and their berthing accommodation is of the best. In short, they seem admirably adapted to the requirements of overseas service. But apart from their lack of protection, they have one serious drawback, viz., excessive cost. An average of nearly £2,000,000 is too high a price to pay for the numerous cruisers that are needed for Imperial defence, and, parenthetically, it is much to be regretted that so large and costly a type should have been accepted as a world's standard under the Washington Treaty. No official trial figures have been published, but the "Berwick" is understood to have reached 32·35 knots on the measured mile, and Press reports credited H.M.A.S. "Australia," of the same class, with a speed of 34 knots on the last stage of her voyage from England to Sydney.

In the second group of 10,000-ton cruisers, "London," "Devonshire," "Shropshire," and "Sussex"—for the design of which the present Director of Naval Construction, Sir William J. Berry, is responsible—certain modifications have been introduced. While the length between perpendiculars, 590ft., is the same, the breadth has been reduced from 68ft. 4in. to 66ft., the external anti-torpedo bulge has been omitted, the shaft horse-power increased from 80,000 to 90,000, and the speed raised to 32 knots. Further, it is reported that oil engines have been installed for cruising purposes. If that be so, we can only say that Sir William Berry and his staff have produced a very remarkable ship, which represents a signal advance in cruiser design. In the "Kent" class it was not found possible to make provision for aircraft. In the "Londons," however, a seaplane and a catapult form part of the equipment. Of the four units composing this group, the nameship and the "Devonshire" were launched in 1927, the "Sussex" on February 22nd, 1928, and the "Shropshire" on July 5th in the same year. The "London" having completed her trials was due to be commissioned on January 1st, 1928, and will relieve the "Frobisher" as flagship of the First Cruiser Squadron, Mediterranean Fleet. In the absence of news to the contrary, it is surmised that the "Dorsetshire" and the "Norfolk," laid down respectively at Portsmouth and the Fairfield yard, Govan, in 1927, are of the same design as the "London" class. The "Norfolk" was launched on December 12th, 1928. The "Dorsetshire" is to go afloat on January 29th. For the present no other 10,000-ton cruisers are building in this country, but one ship of this type is projected in the Navy Estimates for the financial year 1929–30.

H.M.S. "York,"—see Supplement—laid down at Palmer's yard, Hebburn-on-Tyne, in May, 1927, and launched by the Duchess of York on July 17th last, is the first of an intermediate type of cruising ship which may eventually become the standard so far as the British Navy is concerned. Her principal characteristics are as follows:—Length between perpendiculars, 575ft.; breadth, 57ft.; displacement, without fuel, 8400 tons; geared turbine machinery of 80,000 S.H.P. for a speed of 31·25 knots; protection, a 2in. deck over vital parts; armament, six 8in. guns, four 4in. A.A. guns, six torpedo tubes. An auxiliary Diesel plant for use at cruising speed is believed to be installed. Two seaplanes are to be carried on catapults. One has only to compare the "York" with the "Raleigh" class to realise what a tremendous advance has been made in cruiser design in the space of twelve years. The "Exeter," a second ship of the "York" class, was begun at Devonport last August. A third and fourth are about to be laid down at Devonport and Portsmouth respectively, and two further units of the class are included in the programme for 1929–30.

The "Courageous," illustrated herewith, originally a light battle-cruiser, was taken in hand for conversion at Devonport in June, 1924, and completed in March, 1928. She has been rebuilt on much the same lines as the "Furious," except that the boiler uptakes lead into a vertical funnel instead of a horizontal duct. In her new guise the "Courageous," from all accounts, is proving a very successful ship. The cost of reconstructing her was £2,025,800. The "Glorious," a sister vessel, is also being converted into an aircraft carrier. Contracts for a flotailla leader, the "Codrington," and eight destroyers—authorised in the Estimates for 1927–28—were placed with various firms in November, 1927. The leader is being built by Swan, Hunter and Wigham Richardson, and of the destroyers, two are in hand by John Brown and Co., two by Hawthorn, Leslie and Co., two by Scott's Shipbuilding Company, and one each by Thornycrofts and Vickers-Armstrongs. It is understood that the destroyers represent an improvement on the "Amazon" and "Ambuscade." These two boats recently made a cruise to South American ports, a voyage which imposed a severe test on their qualities of seaworthiness and endurance. They are most efficient craft in all respects.

Of the six submarines ordered in 1927, all but one were launched in the past year. The first to go afloat —May 5th—was the "Odin," built at Chatham. The "Osiris," "Oswald," and "Otus" are being built by Vickers-Armstrongs; the "Olympus" and "Orpheus" by Beardmores. These vessels are larger than the "Oberon," the prototype of the "O" class, and displace 1540 tons on the surface. Their designed speed is not yet known. Six further submarines, of the 1927–28 programme, were ordered last year, one from Chatham Dockyard, one from Cammell-Laird, and four from Vickers-Armstrongs. In this order their names are:—"Parthian," "Phœnix," "Pandora," "Perseus," "Poseidon," "Proteus." Two sloops, or "fleet sweepers," of a new type, ordered under the 1927 Estimates, have been launched by Hawthorn, Leslie, the "Bridgewater" on September 14th, 1928; the "Sandwich" a fortnight later. Their leading particulars are:—Length overall 266ft.; breadth, 34ft.; mean draught, 8½ft.; "standard" displacement, 945 tons; machinery, Parsons turbines with single-reduction gearing, driving twin screws, two three-drum oil-burning boilers working at 250 lb.; designed S.H.P., 2000; speed, 17 knots. A 4in. gun and some smaller pieces will be mounted. These ships have been designed principally for service in the East.

Two important Fleet auxiliary vessels, both by Vickers-Armstrongs, were put afloat during the year, the submarine depôt ship "Medway" on July 19th, the repair ship "Resource" on November 27th. Such details of the "Medway" as are known have already appeared in our columns. She is to be propelled by double-acting, two-stroke M.A.N. Diesel engines, each of 4000 H.P., the contract speed being 16 knots. The "Resource," which was described in THE ENGINEER on November 30th, has Parsons steam turbines with a total of 7500 S.H.P. It is expected that orders will shortly be placed by the Admiralty for the seventeen vessels to be built by contract under the current Estimates, viz., one flotilla leader, eight destroyers, one river gunboat, two sloops, and five submarines. The remaining ships of the programme—two 8400-ton cruisers, two sloops, one submarine, and one submarine depôt ship—are to be built in the Royal yards. In view of the shipbuilding depression, the award of the Admiralty contracts for the current financial year is being awaited with more than ordinary interest.

United States.

Shipbuilding operations during the year were confined to the eight cruisers authorised in December, 1924, and a few submarines, and there is consequently little of interest to report. The first two cruisers were laid down in June, 1926, the "Pensacola"—see Supplement—at New York Navy Yard, the "Salt Lake City" by the American Brown-Boveri Corporation at Camden, New Jersey. Both are overdue for launching and they are not likely to be ready before 1930. The other ships were not begun till 1927–28. The "Augusta" and "Houston" are building at Newport News, the "Chester" at Camden, the "Chicago" at Mare Island, the "Northampton" at Puget Sound, and one vessel—not yet named—at the Bethlehem Company's yard, Quincy, Mass. While these eight ships have a standard displacement of 10,000 tons, they are not uniform in design. The first two are flush-decked ships, 585½ft. long overall, with a beam of 65ft. 2in. Propulsion is by geared turbines of 140,000 S.H.P., the contract speed being 33 knots. The armament is exceptionally powerful, consisting of ten 8in. 55-calibre guns, in two triple and two double turrets, and four 5in. A.A. guns. Splinter-proof side armour and a 3in. deck are the protective features. In the six later units the hull has been slightly lengthened and fined down, the speed raised—probably to 35 knots—and the main battery reduced to nine 8in. guns on triple mountings. As these cruisers are the first steam-driven ships of very high speed which have been built in the United States for some years, their trials will be watched with interest. We may interpolate here that, contrary to rumour, the huge aircraft carriers "Lexington" and "Saratoga," which are fitted with the electric drive, are giving complete satisfaction so far as speed is concerned. In spite of slight defects in the turbine blading, which made it necessary to cut out several elements, the "Lexington" has attained 33·04 and her sister ship 33·42 knots. Under the circumstances these are remarkable figures and when the turbine defects have been remedied, both ships should be good for at least 34 knots.

Four flotilla leaders, of about 1800 tons each, are to be built in the near future, but no particulars are available. They will be the first of their type to be ordered for the United States Navy. The mine-laying submarine "V 4" launched in November, 1927, has been completed. With a displacement of 2890 tons above water, she is at present the largest submarine in the world. Her dimensions, &c., are as follows:—Length, 381ft.; breadth, 33½ft.; Diesel engines of 5600 H.P., for a speed on surface of 17 knots; armament, one 6in. gun, four torpedo tubes, 60 mines. She has cost complete £1,230,000. Further submarines of the "V" class, now building at Portsmouth, N.H., and Mare Island, Cal., are believed to have a displacement of more than 3000 tons.

Apart from new construction, the naval yards in America are engaged on extensive alterations to the older capital ships. Six of these have already been modernised, the "Oklahoma" and "Nevada" are now in hand, and the "Pennsylvania," "Arizona" and "California" will be dealt with next. They will receive new boilers, anti-torpedo bulges and additional armour, and have their rig entirely changed. Moreover, the angle of elevation of the turret guns is to be raised from 16 deg. to 30 deg., which will, of course, substantially increase their range. About £1,200,000 is to be spent on each ship.

Japan.

The outstanding events of the year were the completion of the large aircraft carriers "Akagi" and "Kaga," the former of 28,100 tons and 28·5 knots, the latter of 28,000 tons and 23 knots. Both were laid down as capital ships, their conversion being due to the Washington Treaty. The "Akagi," which closely resembles H.M.S. "Furious," measures 763ft. between perpendiculars and has an extreme breadth of 92ft. She carries the very powerful armament of ten 8in. and sixteen 4·7in. guns, the heavy weapons being mounted on the broadside in turrets or casemates. The "Kaga" is 715ft. long, with a beam of 103ft., and has the same armament as "Akagi." Each ship can accommodate about sixty aircraft. Although Japan began building 10,000-ton cruisers in 1924, her first ship of this type, the "Nachi," was only completed in October, 1928. The "Myoko," launched April 16th, 1927, is running her trials; the "Haguro" and the "Ashigara" went afloat respectively on March 24th and May 22nd, 1928. All four ships are identical:—Length between perpendiculars, 630ft.; breadth, 57ft.; draught, 16½ft.; standard displacement, 10,000 tons; geared turbines of 130,000 S.H.P. are installed for a maximum speed of 33 knots; the main armament of ten 8in. guns is mounted in twin turrets on the centre line, three forward and two aft. There are also four 4·7in. A.A. guns and twelve torpedo tubes.

Two seaplanes are carried. These are the most strongly armed and elaborately equipped cruisers at present afloat. The arrangement of the turrets, massive bridgework, and three sharply raking funnels—the first two trunked together—give the ships an extraordinary appearance. They are credited with triple hulls and extensive armour protection, but it is difficult to believe that so many features could be worked into a hull of 10,000 tons. Four more cruisers of this class are under construction.

The "Aoba,"—see Supplement—the last of two cruisers authorised in 1923 was commissioned last January. With her sister ship, "Kinugasa," and two very similar vessels, "Kako" and "Furutaka," built under the previous year's programme, she represents an ingenious and apparently successful attempt to incorporate great fighting power in a hull of modest displacement. All four ships are of 7100 tons standard displacement, and have geared turbine machinery of 100,000 S.H.P. for a speed of 33 knots. They have a uniform main armament of six 8in. guns. In the first two ships these guns are singly mounted in turrets along the centre line, comprising two pyramidal groups at bow and stern respectively. In the "Aoba" and "Kinugasa," however, the six guns are paired, two of the turrets being placed forward and the third one aft. This method probably involves less weight, while permitting equal fire concentration. Characteristics of this class are the wave-lined hull, massive superstructure, and the aeroplane hangar with a catapult. They are said to be very successful ships, though the abnormal deck weights tend, no doubt, to make them rather lively in a seaway. Several destroyers were launched during the year. They belong to a group of twenty-four boats included in the Fleet Replenishment Law of 1926. As first planned, they were to have been flotilla leaders of the most powerful type, with a 6in. armament, but for reasons of economy the design was eventually modified. As completed, they displace 1700 tons, the contract speed is 34 knots, and the armament six 4·7in. guns and nine torpedo tubes. The "Uranami," of this class, took the water at Sasebo on November 29th, leaving only one more boat on the stocks. Further destroyers are projected. Although no submarine launchings were reported, it is certain that a number of new boats have been floated in recent months The largest are those of the "I 53–60" class, with a surface displacement of 1650 tons, a length of 331ft. overall, and a surface speed of 21 knots. These large vessels are obviously intended for ocean cruising. It is noteworthy, indeed, that nearly all Japanese submarines built within the past few years have generous dimensions and a wide radius of action. A mine-layer and four anti-submarine net-laying ships were begun in 1928.

France.

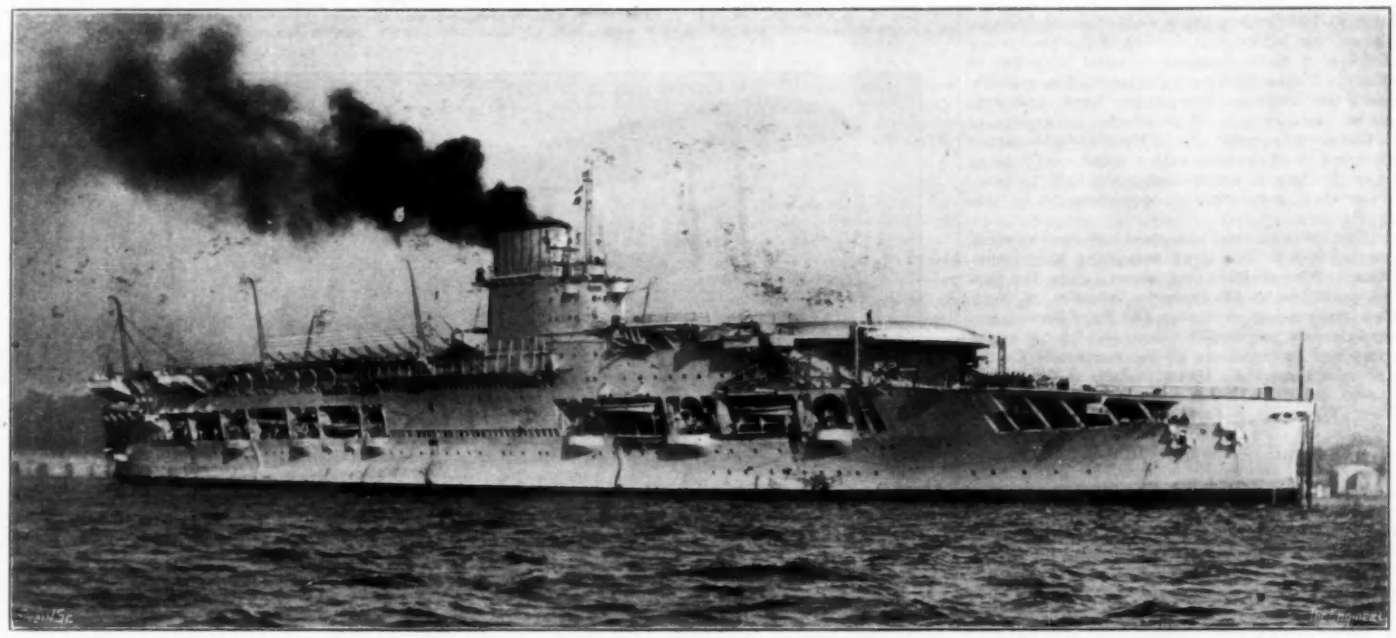
Ships completed, launched, and begun during the year included cruisers, a training cruiser, a mine-layer, and several destroyers and submarines. The "Tourville"—see Supplement—and "Duquesne," cruisers of 10,000 tons, were delivered by the Brest and Lorient yards respectively. These ships have been fully described in previous issues. They are engined for 34·5 knots, but on trial, when in light conditions, the "Tourville" reached 36·15 and the "Duquesne" 35·3 knots. A third ship, "Suffren," of somewhat modified design, better protection and reduced engine power, will be commissioned this month. A fourth ship "Colbert," is to be launched at Brest some time this year, and a fifth unit is on the stocks. They are the first high-speed cruisers to be built in France since long before the war, and the splendid steaming performance of the initial pair reflects great credit on the skill of French naval constructors and engineers. A very interesting ship is the new training cruiser, "Jeanne d'Arc," which was laid down in the summer at St. Nazaire-Penhoët. Particulars:—Length, 525ft.; breadth, 57½ft.; displacement, 6600 tons; turbine machinery of 35,000 S.H.P. for 25 knots; main armament, eight 6·1in. guns in twin turrets disposed *en echelon*. While fulfilling in peace the function of a cadet training ship, this vessel might be useful in war as a second-class cruiser. The mine-layer "Pluton," laid down in April at the same yard, may be not inaptly described as an improved version of H.M.S. "Adventure," though her design is more akin to that of the German "Brummer" and "Bremse." She will displace 5300 tons, the speed is to be 30 knots, and in addition to a large number of mines, she will carry four 5·5in. and ten small guns. A submarine depôt ship, the "Jules Verne," was begun at Lorient in the past year. Displacement, 6000 tons; machinery, Sulzer-Diesel engines of 8000 H.P. for 18 knots. Five flotilla leaders were launched, "Bison," "Guépard," "Lion," "Valmy," and "Verdun." They average 2700 tons, are engined for 35–36 knots, and will mount five or six 5·5in. guns, with six torpedo tubes. Although officially rated as destroyers, these ships are super-leaders of the most powerful type. Eleven of them are now afloat, and ten more remain to be built. Several destroyers of the "Adroit" class were put afloat in 1928. They are boats with a normal displacement of 1495 tons, a speed of 33 knots, and an armament of four 5·1in. and six tubes. In the original post-war building programme, 91 submarines were included, one-third of these being coast defence units. Up to the present, about 55 boats have been built or ordered. Among them are two submersible cruisers, "Surcouf" class, which, displacing 3250 tons each, will be the largest underwater craft in existence. The majority, however, are ocean-going boats of approximately 1550 tons, a speed of 18 knots, and a very heavy torpedo armament. The coast defence boats range from 600 to 630 tons, and have a speed of 14 knots. The "Ondine," the first to be completed, was sunk on October 3rd, 1928, in collision with a Greek steamer.

Italy.

Upon the completion of successful trials, the cruisers "Trento" and "Trieste" have joined the Fleet. These 10,000-ton ships have enormous engine power and are probably the fastest cruisers so far built. Their leading characteristics are:—Length overall, 642ft.; breadth, 67½ft.; mean draught, 19ft. The machinery consists of Parsons turbines with gearing, and twelve Yarrow boilers burning oil. The output is 150,000 S.H.P., producing a speed of 36 knots. Eight 8in. guns in turrets, sixteen 4in. A.A. guns, and eight torpedo tubes are mounted. A light armour belt protects the water line. Two additional cruisers of the same class are now in hand, the "Fiume" at the Stablimento Tecnico, Trieste, and the "Zara" at the Odero-Terni yard near Spezia. Four smaller cruisers, bearing the names of famous "condottieri," were begun during the year, the first at Castellamare dockyard and the other three at the Ansaldo yard, Sestri Ponente. They are exceedingly fast and well-armed scouts. Length, 597ft.; breadth, 57ft.; draught, 14ft.; designed H.P., 95,000 for 37 knots. Main armament, eight 6in. guns mounted in pairs on the centre line. Twelve big destroyers ordered in 1927 are approaching completion. They displace 2000 tons, are engined for 38 knots, and carry six 4·7in. guns, with six tubes. Four destroyers of 1450 tons were ordered during the year. Alike in quantity and quality the Italian torpedo flotilla is of the first rank. Ten submarines of 850–875 tons are under construction.

Germany.

The first of four armoured vessels to replace obsolete battleships was begun at the Deutsche Werke, Kiel, in September. Officially designated a "Panzerschiff," this ship appears to be a compromise between a coast defence monitor and a heavily armed cruiser. Although displacing only 10,000 tons, she is to mount six 11in. guns, probably in triple turrets. A vaulted steel deck of considerable thickness will be worked over all vital parts, the hull will be minutely subdivided, and end-to-end longitudinal bulkheads will afford protection against underwater attack. The hull, electrically welded throughout, will, it is claimed, be of extraordinary lightness. The vessel will be driven by Diesel engines of the double-acting two-stroke type, built in the Deutsche Werke shops. They are reported to have a total output of 30,000 B.H.P. The cost of the ship, complete with armament, is estimated at £4,000,000. On May 20th the cruiser "Köln" was launched at Wilhelmshaven. She is a sister to the "Königsberg" and the "Karlsruhe," already afloat. They displace 6000 tons and have turbine machinery of 65,000 S.H.P. for a speed of 32 knots, but for moderate cruising speeds there is an auxiliary Diesel plant. Nine 6in. guns are mounted in triple turrets, one forward and two aft, *en echelon*. Mines are also carried. These ships are very powerful for their size. A fourth unit is building at Kiel. Four 800-ton destroyers, launched at Wilhelmshaven in March, are the last of a group of twelve boats sanctioned by the naval programme of 1924–25



H.M. RECONSTRUCTED AIRCRAFT CARRIER "COURAGEOUS"

Spain.

The keels of two cruisers were laid simultaneously at Ferrol in August. From the few details available they appear to be ships of 10,000 tons, with an 8in. armament. The cruiser "Cervantes" was launched at the same yard in May. She is a replica of the "Principe Alfonso" and the "Almirante Cervera," 7850 tons, 33 knots, eight 6in. guns, designed by the late Sir Philip Watts. Two flotilla leaders and some submarines are in progress at Cartagena.

Netherlands.

The eight big destroyers designed by Yarrow and Co., but built in Holland, are proving highly successful. The displacement is 1620 tons, and the designed speeds—36 knots light, 34 knots at full load—have been exceeded on trial. These are the first torpedo craft to be designed for carrying a seaplane and a catapult.

Argentine.

Two of the three flotilla leaders ordered in 1927 from J. Samuel White and Co., East Cowes, were launched, the "Mendoza" on July 18th and the "Tucuman" on October 16th, 1928. Displacement, 1520 tons; 36 knots; five 4·7in. guns, six tubes.

Chile.

All of the six destroyers ordered from J. I. Thornycroft and Co. are now afloat. They represent the

largest foreign naval contract that has been placed in Great Britain since the war, its value being about £1,750,000. Two of the boats, "Serrano" and "Orella," launched in January and March, completed their trials, with gratifying results. The class has been fully described in our columns. Vickers-Armstrongs are building for the Chilean Government three submarines, the first of which, the "O'Brien," was launched at Barrow on October 2nd. They are very similar in tonnage and other particulars to the British boats of the "Oberon" class.

Aeronautics in 1928.

No. I.

A CONSIDERABLE amount of sound progress on the technical side, combined with a noteworthy, in some instances a remarkable, increase in the demand for aircraft characterised the activities of the aeronautical industry during the year. It is perhaps going beyond the mark to say that the industry as at present established in this country is in general now in a thriving and prosperous condition. It is, however, no overstatement of the case to say that it is rapidly acquiring increased vitality and is faced with an outlook which justifies a good deal of quiet optimism. A few years ago the situation was greatly different. The industry was barely kept alive by orders received from the Air Ministry for military machines, and there were not a few interested outsiders who wondered how long our two dozen aircraft-building firms and our half-dozen makers of aero-engines would find it possible to keep the doors of their workshops open. Since those days the situation has undergone a considerable change. There have been accessions to, not defections from, the numbers of firms engaged in both branches of the industry, public interest in aviation has steadily increased, the railway companies have bestirred themselves, and are now alive to the advantage of making the aeroplane the ally of their services rather than allowing it to develop into a rival, and foreign Powers are finding it increasingly desirable to place orders for their aeronautical requirements in this country.

Towards this improved situation the development and growing use of the light aeroplane has contributed much. One British firm alone during the past year, in addition to producing a number of large machines, turned out well over 300 light aeroplanes, or more than one per working day, and has orders in hand that will keep it busy at the same rate for the next five or six months. Other makers of light aeroplanes also report a world-wide demand for their machines. There can, in fact, be no doubt that, taking other types of civil machines into consideration, the construction of non-military types of aircraft is becoming a very important part of the activities of the British aeronautical industry. This trend towards prosperity would appear not to be confined to Great Britain. In the United States, twenty-nine aeroplane manufacturers in the first nine months of the year produced between them 2132 commercial machines, or at the average rate of 98 per firm per year. The total estimated production for the year for the whole of the United States aeroplane industry is 3665 commercial machines and about 335 military machines.

On the technical side the year was more remarkable for the development of previously established tendencies than for the introduction of completely novel designs or processes. There was, for instance, a very widespread and extensive application of the Handley Page automatic slot system, not only among British makers, but abroad, as well. In this country automatic slots have now been fitted to examples of all types of aeroplanes from machines of the light pleasure or civil type to the heaviest of military bombers or troop carriers. Steady progress, too, was made with the development of the "all-metal" form of construction. Almost every firm building aeroplanes in this country is now in a position to supply all-metal machines. For a time certain makers clung to a composite structure in which part of the machine framework was made of metal and part of wood. It would appear, however, that such a system can now be regarded as marking merely a transitional period. Of the metals used, duralumin and steel hold the field to the exclusion of practically all others. In some cases the structure is wholly of steel; in others, wholly of duralumin; and in yet others, probably the most numerous, it is partly of the one and partly of the other. The use of duralumin is now unattended by the fears of corrosion troubles, which, for a time, greatly restricted its employment for the stress-bearing members of aircraft. The anodic oxidation process, applied in accordance with the patents held by the Department of Scientific and Industrial Research, is now in almost universal use as a means of preventing corrosion. In the case of steel, an interesting development of recent date was the successful application of welding instead of the usual riveting as a means of uniting the structural members. The corrosion problem in connection with the use of steel has been solved by the employment of stainless steel or by the application of a zinc coating by the Sheradising process to non-stainless steel. The all-metal machine suffers from the disadvantage that in the event of a serious smash the structure does not lend itself as readily to repair as a wooden one. To overcome this objection, one firm at least is now making its steel structures in three distinct parts, any one of which can be completely taken out and replaced in the event of its being seriously damaged.

On the engine side, the developments recorded or made manifest during the year lay in the marked increase in the use of supercharging and in the extensive adoption of reduction gearing in the case of machines fitted with engines of high power. The number of well-tried engines available to the designer is now sufficient to afford him a certain amount of embarassment in his choice. Not many years ago, every type of machine produced was designed to take one particular make of engine; in fact, in some notable instances, the machine was built round the engine, and was largely inspired by it. To-day, there is a distinct tendency towards a reversal of this policy. Machines of various classes are now being produced which are designed to take any one of a range of different engines, even although the provision of facilities for interchanging the engine may involve some increase in the dimensions and weight of the machine.

Below, following our usual practice, we summarise the work done during the year by some of the principal firms engaged in the aeronautical industry in this country.

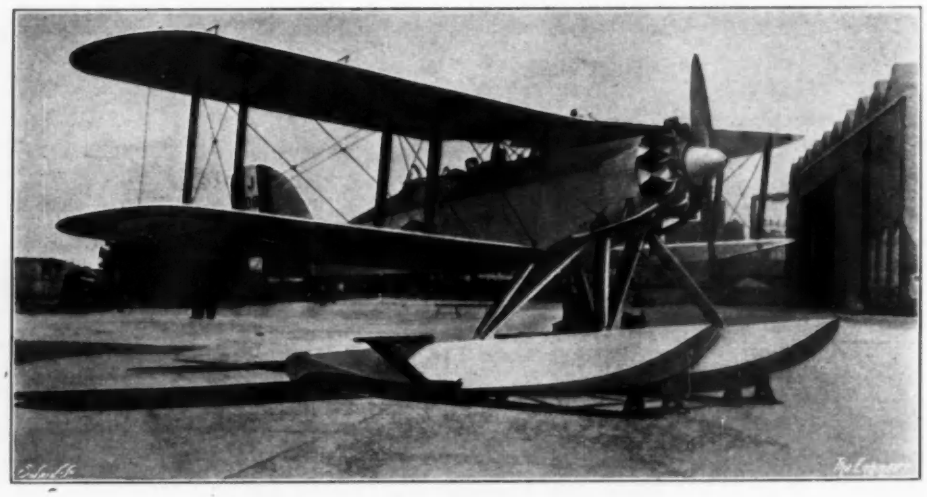
The British Aeronautical Industry.

Boulton and Paul, Ltd.—At the Norwich works of Boulton and Paul, Ltd., the year saw the successful completion of the firm's contract with the Air Ministry for the designing and constructing of the hull structure of H.M. airship "R 101." This work was begun in 1924 and may be regarded as a development of the firm's activities in the construction of "all-metal" aeroplanes. In our issues of November 30th and December 7th we published in some detail an account of the design and construction of the airship members for which the firm was responsible. An outstanding feature of the work was the development of processes for the drawing or rolling of stainless or other steel strip to various sections in the soft state and for a continuous heat treatment whereby the sections could subsequently be hardened and tempered. Other processes employed covered the rolling or drawing of duralumin strip to various sections or its punching and flanging to form the webs of girders, the production of aluminium-silicon die castings, the manufacture of a large number of accurately machined stampings and the making up of fork-ended bracing cables. Another important aspect of the firm's work consisted of providing protection against corrosion in the case of members other than those made of stainless steel. Those members which were made of non-stainless steel were zinc coated by the Sherardising process. Parts made of duralumin were rendered resistant to corrosion by means of the anodic oxidation process. The various members, after being manufactured and assembled at Norwich, were shipped to the Royal Airship Works at Cardington, where they were erected and built into the hull structure by the staff of those works. It says a very great deal indeed for the care and accuracy exercised by Messrs. Boulton and Paul in the fabrication of the parts and members of the airship hull, that the gigantic structure has met with no check in its erection.

On the aeroplane side the firm entered upon the production in quantity of the all-metal twin-engined "Sidestrand" day bomber, which we illustrated in our review of aeronautics a year ago. The design was adapted to take Bristol "Jupiter," Mark VIII. geared engines in place of the Mark VI. ungeared engines originally fitted. The performance was improved as a result of the change, but figures to illustrate it cannot be given at present. A new machine completed early in the year was the single-seater "Partridge" fighter, of which an illustration is given in one of our Supplements. As illustrated, this machine is fitted with a Bristol "Jupiter," Mark VII., super-charged engine, but the design is such that other engines of higher power can be taken. As a consequence the machine is somewhat larger than it would have been if designed solely for the "Jupiter" Mark VII. engine, but its performance figures are, nevertheless, of a very high order. In its wing section, and in the fact that its body shape has been developed from a basic Joukowsky streamline form, the "Partridge" resembles the "Sidestrand" machine. Like that machine, too, its structure makes use of the system of standardised metal members which the firm has evolved as a result of its many years of experience in the rolling and drawing of steel and other sections for aeronautical purposes. As illustrating the significance of this system, we may state that the firm is in a position to supply, for its own use or the use of others, eighteen different sizes or shapes of steel wing spars by variously combining three different standard webs and six different standard flanges. By altering the gauge of the strip metal employed or by changing the material from steel to duralumin the range available is still further increased.

The "Partridge" has a top plane span of 35ft. and a bottom plane span of 31ft., the chords being 5ft. 6in. and 4ft. 6in. respectively. The overall length is 25ft. 8in. and the gross weight 3160 lb. At 10,000ft. the speed is 167 m.p.h. and at 26,000ft. 153 m.p.h. The landing speed is 61 m.p.h. The machine can climb to 15,000ft. in ten minutes, and to 26,000ft. in twenty-six minutes.

Westland Aircraft Works.—In our review of aeronautics a year ago we illustrated and described the "Wapiti" two-seater general purpose biplane produced by the Westland Aircraft Works of Yeovil.



WESTLAND "WAPITI" GENERAL PURPOSE SEAPLANE

That machine was suitable for bombing, reconnaissance, photography, wireless and advanced training. During the past year the "Wapiti" was accepted by the Royal Air Force as a general purposes aircraft, and at the Yeovil works attention on the productive side centred mainly on the manufacture of the "Wapiti" in various forms. Large numbers of "Wapitis" were delivered to R.A.F. stations at home and abroad. In addition to the land type, the machine was developed as a seaplane, thereby still further adding to its general usefulness. In that capacity it showed itself, we are informed, capable of behaving well. We illustrate the seaplane adaptation herewith.

The earliest design of "Wapiti" was fitted with a "Jupiter" VI. engine—ungeared—and was of a composite structure, being mainly metal from the forward end to behind the pilot's cockpit and thereafter of wood. In a later development the "Jupiter" VI. engine was retained, but the structure was made of the all-metal type throughout. A still later development consisted of an all-metal machine fitted with a "Jupiter" VIII. geared engine. A considerable number of this latest type of "Wapiti" is now being built for the Royal Air Force, and, in addition, twenty-eight machines of the same design, except for certain features dictated by the different conditions under which they will be operated, are under construction for the Royal Australian Air Force. The Handley Page automatic slot is now fitted to all "Wapiti" machines and the benefit obtained is stated to be most marked.

In addition to this military work the firm delivered to the Royal Air Force the Hill tailless or "Pterodactyl" Mark II. machine and a new type of fast monoplane known as the Westland "Wizard," of which we reproduce a photograph on page 14. The "Wizard" is of the so-called parasol type and is stated to be one of the fastest military machines yet accepted by the Air Ministry. It is a single seater and has, we believe, a speed of about 190 miles an hour at a height of 10,000ft.

On the civil side the firm developed the Westland "Widgeon" as a two seater for pleasure and business flying. One of the developments made in this machine during the past year consisted of fitting it with Handley Page automatic slots and, for use in undeveloped countries, with an undercarriage having a split axle. The "Widgeon" can now be supplied fitted with either a Cirrus, Genet, or Gipsy engine.

Blackburn Aeroplane and Motor Company, Ltd.—For reasons of economy and also to secure increased efficiency and room for expansion the Blackburn Aeroplane and Motor Company decided a short time ago to transfer the whole of its Leeds organisation to Brough, on the Yorkshire coast, where, previously, it maintained an experimental and seaplane testing station. During the year the company took another interesting step in developing its facilities for metal construction. The plant now installed consists of rolling mills, draw benches, pneumatic drilling and riveting machines and equipment for the heat and electrical treatment of metals. One outcome of this development is to be seen in the fact that the firm's "Bluebird" two-seater light aeroplane or seaplane is now being produced with an all-metal structure.

The company continued to develop the "Iris" triple-engined metal flying boat and the "Ripon" single-engined torpedo plane, a machine capable of carrying a pilot and a gunner and a military load, such as a torpedo, weighing just short of 2000 lb. Earlier examples of both these machines have been illustrated by us on past occasions. Of the new machines produced by the firm we are permitted to mention only the "Lincock" light single-seater fighter, of which we give an illustration in one of our Supplements. This machine has been designed to carry out exactly the same duties as the heavier and more highly powered single-seater fighter usually employed for offensive action, escort duties and aerial attack against ground forces. Its light construction, it is claimed, greatly increases its manœuvrability. In spite of the fact that it is fitted with an engine of reduced power, its performance, its makers state, is very nearly equal to that of the heavier and more highly powered machines of its type. Its cost, both to produce and to operate, is also less, and as a consequence it is particularly recommended for advanced training work. It can be adapted for certain civil work, such as fast mail-carrying, police and Customs patrol work. The machine is made either with an all-metal or a composite structure. Its high performance is ascribed to the extreme care taken in eliminating interference between its parts and in producing it on "clean" lines. Its manœuvrability is attributed to the proportioning of its control surfaces combined with the concentration of the main items of weight, such as the engine, pilot and military load, as near the centre of gravity as possible. The machine can be fitted either with an ordinary or a supercharged Armstrong-Siddeley "Lynx" engine. Its performances in the two cases are interesting as illustrating the effect secured by supercharging. We set them out side by side below :—

Blackburn "Lincock" Light Single-seater Fighter, Armstrong-Siddeley "Lynx" Engine.

	Ordinary.	Supercharged.
Top speed, ground level, m.p.h. ..	145 ..	140
Top speed, 10,000ft., m.p.h. ..	133 ..	153
Top speed, 15,000ft., m.p.h. ..	123 ..	147
Rate of climb from ground level, feet per minute	1,200 ..	1,020
Rate of climb at 10,000ft., feet per minute	600 ..	930
Time to 10,000ft., minutes	12¼ ..	9¾
Service ceiling, feet	17,500 ..	23,300

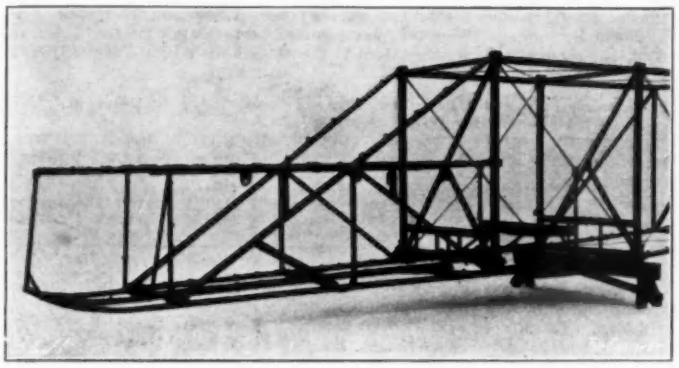
De Havilland Aircraft Company, Ltd.—Great activity prevailed during the year at the Edgware works of the De Havilland Aircraft Company, Ltd., chiefly on the production in large numbers of the firm's light two-seater "Moth" aeroplane. On the technical side the year saw the production of the first "Gipsy Moth" machine, the original design modified to take the firm's own engine, the de Havilland "Gipsy" of 85–100 horse-power. Three "Gipsy Moths" were entered for the King's Cup race in July and finished first, fourth and sixth. A few days later Captain de Havilland, with Mrs. de Havilland as passenger, took a "Gipsy Moth" to a height of 19,980ft., thereby creating a world's altitude record for light two-seater aeroplanes. During the following month Captain Broad, the company's chief test pilot, succeeded in remaining in the air on a "Gipsy Moth" for a continuous period of twenty-four hours. The "Gipsy Moth" is now being made as an open cockpit landplane, as a seaplane and as a landplane fitted with a *coupé* head, which permits the pilot and his passenger to fly without special clothing or equipment. In the last-named form the machine is illustrated in one of our Supplements.

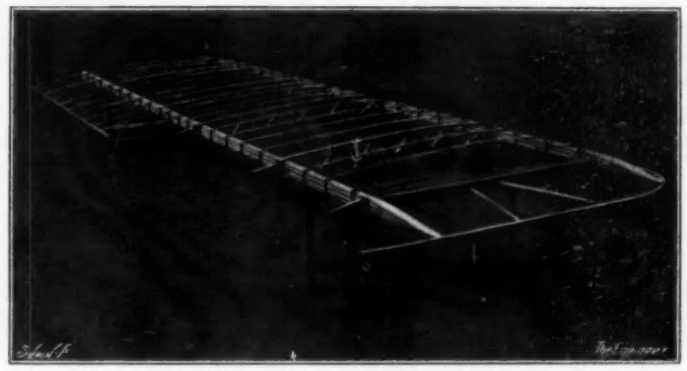
The first "Moth" machine was produced in February, 1925, and during that year fourteen examples were built. In 1926 the production rose to thirty-four and in 1927 to 117 machines. During the first ten months of 1928 no fewer than 273 machines of the "Moth" type were turned out. In addition to these "Moth" machines the firm, during the year, built four DH 61 eight-seater commercial machines for Canada, Australia, and for use in this country by a London newspaper. Large orders remain in hand and include 120 "Moths," two DH 61 machines for Queensland, and four DH 66 "Hercules" machines to carry sixteen passengers and fitted with three engines for West Australia. In addition, orders for 167 "Gipsy" engines by themselves are in hand. Altogether during 1928 the firm executed orders to the value of about £200,000 and is engaged upon orders valued at about £150,000. Its activity has naturally led to a great increase in the size of its works at the Stag Lane Aerodrome. In 1921 its establishment consisted of a small block of offices and one hangar. During 1928 the ground built upon by way of extensions covered an area of 122,000 square feet. The extensions provided took the form of new engine factories, erecting shops, boiler-houses, test houses, shops for the construction of the "Moth," repair shops, warehouses, a service station, lock-up sheds for private "Moth" owners and experimental workshops.

Handley Page, Ltd.—In our review a year ago we devoted some space to a description of the Handley Page automatic slot system for aeroplane wings, one of the most important technical advances made in the whole history of practical aeronautics. During the past year the firm continued to develop and improve the automatic slot. Since the first machine fitted with this device, the Handley Page "Harrow" Mark I., was flown in August, 1927, very great progress has been made. Slotted machines are now being flown in every country in the world and many Governments have bought or are considering buying the slotted wing rights. The firm is still experimenting with the device, for its action is very complex and demands much research work.

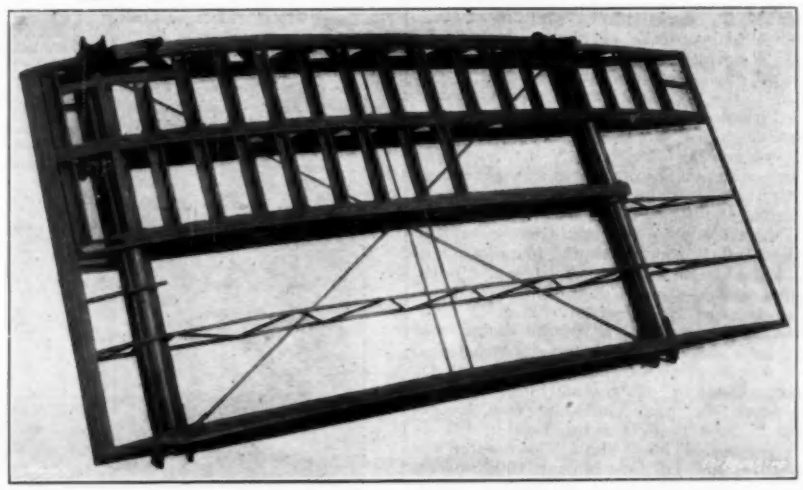
Of the machines produced during the year three may be specially mentioned. The "Harrow" Mark II. is a single-engined torpedo carrier completely slotted. The slot extends along the full length of the leading edge of the top wings, including the centre section. At either end of the wings the slot is of the automatic type, while the intervening portion is of the main lift type. The main lift slot is used when landing or taking off to reduce the speed at which these operations are performed. The automatic slots come into action when the machine is in danger of stalling or has stalled and give the pilot a measure of lateral control against the spin which would develop in an unslotted machine.

The Handley Page "Hinaidi" represents a development of an earlier and well-tried design of heavy night bomber known as the "Hyderabad," the chief difference being that the "Hinaidi" is fitted with two "Jupiter" VIII. engines with 2 to 1 reduction gearing in place of two Napier "Lion" XI. engines. At the firm's Cricklewood works a "Hinaidi" machine is being produced with an all-metal structure in place of the wooden structure previously employed. In three of the accompanying engravings we show the type of metal construction being used. The fuselage is built of tubular steel members, which, it is very interesting to note, are welded together instead of being united in the usual way by pins and socket fittings. The wings are composed of built-up corrugated duralumin spars and built-up duralumin ribs. The third engraving illustrates the construction of the bottom centre section or wing root to which the lower wings are attached, one such root being placed on each side of the fuselage.





TUBULAR STEEL FUSELAGE AND DURALUMIN WING FRAME OF HANDLEY PAGE "HINAIDI" NIGHT BOMBER



DURALUMIN BOTTOM CENTRE SECTION FOR "HINAIDI" BOMBER

The third machine to which we will refer is the "Clive" twin-engined troop carrier, of which an illustration appears on page 14. This machine is built very much on the lines of the "Hinaidi" bomber. It is, however, provided with windows in the fuselage and inside, as shown in an engraving on page 14, is fitted with collapsible seats. Its power units are the same as those of the "Hinaidi." It possesses a very wide range and is capable of carrying a load of twenty-three men with their equipment and guns.

Vickers (Aviation), Ltd.—In June a company, known as Vickers (Aviation), Ltd., was formed under the chairmanship of Sir Robert McLean to take over the Weybridge Aircraft Factory and the aviation business generally of Vickers, Ltd. The new company is entirely owned and controlled by Vickers, Ltd., and is not included in the recent Vickers-Armstrong amalgamation. Quite recently it was announced that it had acquired the entire share capital of the Supermarine Aviation Works, Ltd., of Southampton. The directorate includes Sir Mark

Webster-Jenkinson, Commander James Bird, of the Supermarine Company, and Air Commodore J. A. Chamier, who has resigned from his position as Technical Director at the Air Ministry to assume the technical direction of the combined companies.

The Weybridge factory has for some years past devoted close attention to the construction of machines with all-metal—duralumin—structures and fabric coverings. During 1928 this system of construction was farther developed. An example of the firm's recent practice in this direction is the "Vellore" single-engined land plane built to the order of the Air Ministry, as a commercial freighter for allocation to Imperial Airways, Ltd. This machine, of which a photograph is reproduced in one of our Supplements, is driven by a Jupiter IX. engine. It has a total laden weight of 9500 lb., can travel at a maximum speed of 110 m.p.h., and a minimum speed of 48 m.p.h., and can climb to 4920ft. in 12 min. With 728 lb. allocated to the fuel and oil load and 376 lb. to the two pilots and their equipment, there remains a freight-carrying capacity of over 3700 lb., representing a paying load of 7·65 lb. per normal horse-power. The machine is 51ft. 6in. in length, 16ft. 3in. in height, and 76ft. in span. The wings have a chord of 9ft. 6in. and a plane area of 1416 square feet. In the interior of the fuselage, as illustrated on page 14, there is a large all-metal electrically-lighted hold, capable of taking 225 cubic feet of goods and fitted with a traversing system of pulley blocks and rollers for dealing with heavy articles. Access to the hold is obtained through a hatch measuring 5ft. 8in. by 3ft. 7in. This hatch is placed in the underside of the fuselage immediately aft of the hold, so as to leave the whole of the hold floor free for the storage of freight. The hold measures 12ft. 10in. long by 4ft. wide by 4ft. 10in. high. At the after end it is open to the interior of the rear portion of the fuselage, so that lengthy articles, such as rods or tubes up to 23ft. long, can be accommodated.

The petrol is carried in two tanks, having a combined capacity of 162 gallons, or sufficient for a cruising range of 670 miles. A Vickers-Pott oil cooler and an engine starter are included in the equipment of the machine. By the unscrewing of a single pin in each wing, the wings can be folded to give an overall width of 20ft. 9in This folding is effected without disturbing any of the petrol or other piping. The undercarriage has a wide track and is of the vee type without axle. It is fitted with the Vickers oleo-pneumatic shock-absorbing system, and can be entirely removed and replaced in less than 15 min. The tail skid is of the Vickers oleo type, and can be fitted with an extra large pan for use when the machine has to operate from soft or sandy aerodromes. The machine is stated to possess a high degree of inherent stability, so much so that it is unnecessary to provide dual control. Instead, provision has been made to enable the two pilots, who sit side by side in the nose of the machine, to change places while in the air. The "Vellore" is constructed almost entirely of duralumin. The wings, tail units and the portion of the fuselage aft of the hold are fabric covered.

In addition to the "Vellore," the Weybridge works were engaged on the production of several interesting types of new machines, which are still on the official secret list, and on the improvement of other types which we have mentioned in previous annual reviews of aeronautics. Among the works of improvement, we may mention the fitting of all-metal wing cellules to the "Virginia" class of twin-tractor biplane night bomber and the experimental installation of Jupiter IX. geared engines on the same class. Similar reconditioning work was carried out on the "Victoria" class of twin-engined troop carrier. The "Vimy" twin-engined biplane bomber, a veteran design, was given a new lease of life as an advanced instructional machine for twin-engined training in the Royal Air Force. Reconditioning of the machines for this purpose includes the replacement of the original Rolls-Royce "Eagle" engines by Jupiter VI. or Jaguar IV. engines. The "Vivid" two-seater all-metal general purpose military biplane, illustrated a year ago, completed very satisfactory trials as a float seaplane. It showed itself capable of climbing to 9840ft. in 13 min., of attaining a speed of 120 knots at 4920ft., and of giving a minimum speed of 47·5 knots at ground level. During the year the "Vivid"—as a landplane—was flown in three stages from Croydon to Bucharest in one day by the firm's test pilot, Flight-Lieut. E. R. C. Scholefield. The total distance of about 1500 miles was covered in approximately 10 hours' flying time. The "Vendace," advanced training machine fitted with a Hispano engine, which we illustrated two years ago, was the subject of a contract for a foreign Government. A machine of this class, fitted with a float chassis and an A.D.C. "Nimbus" engine, was successfully employed on air survey work in South America by the Aircraft Operating Company, Ltd. As a development of the all-metal fabric-covered scout biplane, known as the Vickers type 123, the firm is now engaged upon the production for a foreign Power of a single-seater, which it is expected will have a speed of 153 m.p.h., at 13,120ft., and will be able to climb to that height in 8 min. Its ultimate ceiling will be about 27,900ft., and its minimum speed at ground level 52 m.p.h.

(To be continued.)

Motor Vessels and Marine Oil Engines in 1928.

No. I.

ALTHOUGH the year which has just ended was not distinguished by the completion of any very large motor passenger liners, and there were comparatively few passenger and cargo vessels finished, there was, nevertheless, marked activity in motor ship construction, which increased the number of ships built by 80 per cent. compared with last year's returns. This increase was nearly 100 per cent., if account is taken of all the ships launched and now fitting out for trials. In a similar way the motor shipbuilding returns throughout the world showed a remarkable advance, and the increase on last year's returns may be assessed at about 40 per cent. Great Britain and Northern Ireland again held the leading place among the countries of the world in tonnage completed. In Table I. given below, the returns for each year, as recorded in THE ENGINEER, are given along with the total gross tonnage and the indicated horse-power of propelling machinery. It is of interest to note the very large advance in last year's figures in comparison with the almost unchanged tonnage output of the four preceding years. If we may judge from the work at present in hand, it seems more than likely that this increased rate of motor shipbuilding may be sustained.

TABLE I.—*Vessels of 1000 Gross Tons and Upwards Fitted with Marine Oil Engines and Completed in Great Britain and Ireland During the Years 1920–1928 Inclusive.*

Year	1920.	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.
Vessels completed	7	15	17	14	43	44	30	40	73
Total gross tons	53,407	83,980	114,527	78,862	231,764	282,325	212,063	228,751	468,477
Total I.H.P.	31,140	42,860	69,820	49,137	145,130	180,125	160,460	174,905	305,960

As in other years, we give in Table II. detailed particulars of the hulls and propelling machinery of all the motor vessels built and engined in this country and placed in commission during 1928. The number of passenger and cargo vessels is not large, there being only six such vessels out of a total of seventy-three. The remainder is made up of cargo vessels and oil and molasses tankers. This latter group includes no less than twenty-nine ships. In the main, the orders were from British firms, but some notable American and Scandinavian orders were completed. A certain degree of standardisation in hull design is apparent, but there is considerable diversity in the type of engine adopted, owing no doubt to the effect of both British and foreign competition. The speed of cargo ships has tended to increase, and 14½-knot motor vessels are now quite usual.

The Large Motor Passenger Liner.

The continued success of the large motor passenger liners now in service influenced favourably the placing of new orders for large motor vessels. During the past year the Union Castle Mail Steamship Company, Ltd., placed with Harland and Wolff, Ltd., two orders for 20,000-ton motor passenger liners and one for a similar vessel of 11,000 tons. These ships were ordered as a result of the very satisfactory performances of the "Carnarvon Castle" and her sister ships. Work is well in hand at Belfast on the new 26,000-ton motor liner "Britannic" for the White Star Line. All these vessels will be propelled by double-acting four-stroke Harland-B. and W. type motors. One of the events of the year was the placing of an order with Harland and Wolff, Ltd., for a 60,000-ton, 1000ft. White Star liner. Although it is now definitely known that this giant ship will be electrically propelled, no final decision has yet been made as to the type of main propelling machinery. There are many, however, who regard with favour the oil-electric drive. Should it be adopted it is probable that a total propelling and auxiliary horse-power of not less than about 180,000 S.H.P. would be required.

The 17,500 gross ton quadruple-screw motor liner "Aorangi," which was completed by the Fairfield Shipbuilding, and Engineering Company, Ltd., in 1925, and equipped with Fairfield-Sulzer two-stroke opposed-piston type of oil engine, especially for large passenger liners and cargo vessels.

Some Notable Building Programmes.

Several notable shipbuilding programmes were completed in 1928, and extensions were made to existing motor shipping fleets. With the delivery of the motor vessel "King William," Harland and Wolff, Ltd., completed for the King Line, Ltd., a fleet of nine motor vessels. One of these ships, the "King John," is shown in Fig. 1. They are single-screw cargo ships, with a designed speed of 10 knots, and are propelled by a single six-cylinder 1850 S.H.P. oil engine, running at 95 r.p.m. The auxiliary machinery is electrically operated. With the two vessels "Ponzano" and "Pinto," further additions were made to the MacAndrews' fleet of fruit-carrying ships.

Two of the largest motor ships of the year are the 10,600-ton passenger and cargo liners "Santa Barbara" and "Santa Maria," built for the Grace Line, Ltd., of New York, by the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees. A view of the "Santa Barbara" is reproduced in Fig. 2, and the principal particulars are given in Table II. The main and auxiliary machinery was supplied by Sulzer Brothers, of Wintherthur. Towards the end of the year the same owners placed an order for a sister ship, but she will be built in America under the provision made by the Jones-White Act, and the turbo-electric drive will be adopted.

Other Sulzer-engined ships include four high-powered refrigerated-cargo carriers for the Shaw Savill and Albion Company, two of which—the "Karamea" and "Taranaki"—were built on the Clyde by the Fairfield Shipbuilding and Engineering Company, Ltd., of Govan, and two—the "Zealandic" and the "Coptic"—by Swan, Hunter and Wigham Richardson, Ltd., at Wallsend. Fairfield-Sulzer and Wallsend-Sulzer propelling machinery was fitted. Two other Fairfield-built and engined ships are the refrigerated meat carrier "Dunster Grange"—see to-day's Supplement—and the sister vessel "El Argentino," both of which are among the largest ships engaged in the South American chilled meat trade. With the completion of the "Highland Monarch," also illustrated in our Supplement pages, a beginning was made with the five ships for Nelson Lines, Ltd. These ships represent Harland and Wolff's latest practice in double-acting four-stroke machinery. The ships are pleasing examples of design and craftsmanship as regards the passenger accommodation, and many original ideas are embodied in them. Before the close of the year two further vessels, the "Highland Chieftain" and

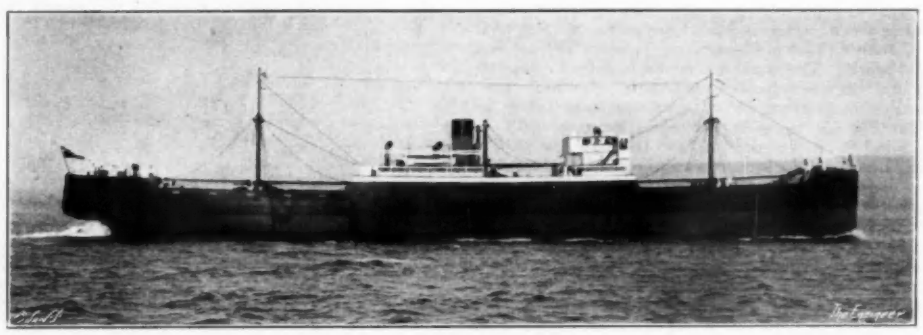


FIG. 1—THE KING LINE MOTOR CARGO SHIP "KING JOHN"

TABLE II.—BRITISH BUILT MOTOR SHIPS AND MARINE OIL ENGINES, 1928.

Owners.	Name of ship.	Speed and type of ship.	Shipbuilder.	Hull particulars.				Type of propelling machinery.	Main engine particulars.					Number and kW size auxiliary generator sets
				Length B.P.	Breadth m'lded.	Depth, m'lded.	Gross tonn'ge.		Cyl. bore.	Piston stroke.	R.p.m.	Total I.H.P.	Total S.H.P.	
				Feet.	Feet.	Feet.			mm. & in.	mm. & in.				
Anglo-American Oil Co., Ltd.	Chesapeake	11½-knot tankers	Workman, Clark and Co., Ltd.	470	64·25	34·75	8,955	One 8-cyl, 2-stroke, S.A., Workman-Sulzer	680	1,200	90	4,520	3,500	Two 40 kW.
	Schuylkill	,,	Sir J. Laing and Sons, Ltd.	470	64·25	34·75	8,964	One 4-cyl., 2-stroke, opposed-piston Doxford	620	1,240	90	4,120	3,500	3, 40 kW
Argentine Navigation Co., Ltd.	Ciudad del Salto	12-knot pass.	Harland and Wolff, Ltd.	250·5	42·15	9·7	1,952	Two 6-cyl., 2-stroke, S.A., Harland B. & W.	400	700	180	1,600	1,220	2, 65 kW
Atlantic Refining Co., Philadelphia	Brunswick	11-knot tanker	Scott's Shipbuilding and Engineering Co., Ltd.	469	63	26·5	8,947	Four 6-cyl., 4-stroke, S.A., airless Ingersoll-Carels	19½	24	225	3,740	2,800	4, 600 kW, 4, 75 kW
Avenue Shipping Co., Ltd.	Winton	10-knot cargo	William Hamilton and Co. (1928), Ltd.	375·2	53·6	25·7	4,388	One 8-cyl., 4-stroke, Kincaid-Harland-B. & W.	630	1,300	105	2,400	1,950	Electric
H. Borthen and Co., Oslo	Elsa	11½-knot tankers	Barclay, Curle and Co., Ltd.	400	52·5	29·25	5,187	One 3-cyl., 2-stroke, opposed piston, Barclay-Doxford	580	2,320	84	2,500	2,000	Electric and steam
	Jenny	,,	Swan, Hunter and Wigham Richardson, Ltd.	344	54·4	28	4,706	One 6-cyl., 2-stroke, S.A., Swan Hunter Polar	600	1,200	84	2,700	2,000	Electric and steam
C. T. Bowring, Ltd.	Benedick	11½-knot tanker	Blythswood Shipbuilding Co., Ltd.	431	58·2	32·9	6,954	One 6-cyl., 4-stroke, S.A., Kincaid-Harland-B. & W.	740	1,500	110	3,130	2,300	Electric and steam
British and Argentine Steamship Co.	El Argentino	14½-knot cargo	Fairfield Shipbuilding and Engineering Co., Ltd.	430	64·3	38·12	9,590	Two 6-cyl., 2-stroke, S.A., Fairfield-Sulzer	28½	39	118	8,200	6,400	4, 165 kW sets
British Oil Shipping Co., Ltd.	Oilpioneer	10½-knot tanker	Swan, Hunter and Wigham Richardson, Ltd.	410	53·5	31	5,666	One 7-cyl., 2-stroke, S.A., Swan Hunter Polar	600	1,200	100	3,300	2,550	2, 65 kW
British Empire Steam Navigation Co., Ltd.	Caroni River	11½-knot tanker	Blythswood Shipbuilding Co., Ltd.	456	59	33·75	7,807	One 8-cyl., 4-stroke, S.A., Kincaid-Harland-B. & W.	740	1,500	110	3,750	2,850	Electric and steam
British Tanker Co., Ltd.	British Courage	11-knot tankers	Lithgows, Ltd.	440	56·75	33·9	6,980	One 8-cyl., Kincaid-B. & W.	740	1,500	98	3,700	2,900	2, 66 kW, 1, 10 kW
	British Freedom	,,	Palmer's Shipbuilding and Iron Co.					One 4-cyl., Richardsons-Doxford	580	2,320	84	3,380	2,870	
	British Dominion	,,	Swan, Hunter and Wigham Richardson, Ltd.					One 4-cyl., Doxford	580	2,320	81	3,210	2,880	
	British Glory	,,	Sir J. Laing and Sons, Ltd.					One 4-cyl., Doxford	580	2,320	82	3,130	2,800	
	British Hope	,,	Caledon Shipbuilding Co., Ltd.					One 8-cyl., B. & W.	740	1,500	114	3,990	3,000	
	British Honour	,,	Palmer's Shipbuilding and Iron Co., Ltd.					One 6-cyl., Sulzer	680	1,200	101	3,780	2,770	
	British Reliance	,,	Greenock Dockyard Co., Ltd.					One 8-cyl., Kincaid-B. & W.	740	1,800	98	3,700	2,700	
	British Renown	,,	Sir J. Laing and Sons, Ltd.					One 4-cyl., Richardsons-Doxford	580	2,320	82	3,130	2,800	
	British Justice	,,	Palmer's Shipbuilding and Iron Co., Ltd.					One 4-cyl., Richardsons-Doxford	580	2,320	84	3,380	2,870	
	British Pluck	,,	Swan, Hunter and Wigham Richardson, Ltd.	230	31·5	13·9	1,225	One 6-cyl., 2-stroke, S.A., Swan Hunter Polar	420	720	135	1,240	810	
Clan Line, Ltd.	Clan Macdonald	14-knot cargo	Greenock Dockyard Co., Ltd.	439·25	57·5	39·5	6,051	One 8-cyl., 4-stroke, D.A., Harland-Kincaid-B. & W.	680	1,400	110	6,400	5,000	3, 120 kW, 1, 100 kW
Commonwealth and Dominion Line, Ltd.	Port Fairy	15-knot cargo	William Doxford and Sons, Ltd.	475·5	63	43·4	7,980	Two 4-cyl., 2-stroke, opposed-piston Doxford	600	2,320	98	8,400	7,400	3, 250 kW
	Port Alma	,,	,, ,, ,,											
Elder, Dempster and Co., Ltd.	Dagomba	12-knot cargo	Ardrossan Dockyard Co., Ltd.	355	49·2	31·2	3,845	One 6-cyl., 4-stroke, S.A., Harland-B. & W.; ditto, Kincaid-Harland	740	1,500	86	2,570	1,940	3, 65 kW
	Deido	,,	Arch. MacMillan and Co., Ltd.											
Ellerman Lines, Ltd.	City of Lille	14-knot cargo	Barclay, Curle and Co., Ltd.	447·7	57·7	30·1	6,583	One 4-cyl., 2-stroke, Barclay Curle-Doxford	680	2,720	87	5,000	4,500	3, 110 kW
Entre Rios Railways	Delfina Mitre	Train ferry	A. and J. Inglis, Ltd.	340	57·7	17·7	1,750	Two 8-cyl., 4-stroke, S.A., Harland-B. & W.	400	750	155	1,850	1,400	Electric
Freshmoor Navigation Co., Ltd.	Freshmoor	11-knot tanker	Wm. Doxford and Sons, Ltd.	210	34·3	17·9	1,073	One 3-cyl., 2-stroke, opposed-piston Doxford	400	1,300	125	800	650	2, 36 kW
Furness, Withy and Co., Ltd.	Pacific Exporter	13-knot cargo	Blythswood Shipbuilding Co., Ltd.	435	60	42	6,275	Two 8-cyl., 4-stroke, S.A., Kincaid-B. & W.	630	1,300	110	4,550	4,000	Electric aux.
	Pacific Pioneer	,,	,, ,, ,,											
Grace Line, Ltd.	Santa Barbara	16½-knot pass.	Furness Shipbuilding Co., Ltd.	486	64	25·4	8,879	Two 8-cyl., 2-stroke, S.A., Sulzer	680	1,200	100	11,500	8,000	4, 275 kW
	Santa Maria													
Gulf Refining Co., Ltd.	Gulf Bird	11½-knot tankers	Furness Shipbuilding Co., Ltd.	511	69·5	36·7	10,848	One 4-cyl., 2-stroke, Doxford and Doxford-Richardsons-Westgarth	640	1,240	84	3,850	3,260	2, 90 kW 1, 30 kW
	Gulf Hawk	,,	,, ,, ,,											
	Gulf Wing	,,	,, ,, ,,											
P. Gjering, Bergen	Binta	10½-knot tanker	Armstrong, Whitworth and Co., Ltd.	396·4	55	32·3	5,873	One 6-cyl., 2-stroke, S.A. Polar (Atlas Diesel Co.)	600	1,200	100	2,700	2,000	2, 45 kW
Alfred Holt and Co.	Eurybates	14-knot cargo	Scott's Shipbuilding and Engineering Co., Ltd.	425	54·5	32·75	6,400	Two Scott-Still motors; 5-cyl., S.A., 4-stroke; 2-cyl., D.A., steam	27 24	45 45	105	6,500	5,000	4, 100 kW
Houlder Line, Ltd.	Dunster Grange	16-knot cargo	Fairfield Shipbuilding and Engineering Co., Ltd.	430	64·25	38·12	9,494	Two 6-cyl., 2-stroke, S.A., Fairfield-Sulzer	28½	39	118	8,200	6,400	4, 165 kW
Hunting and Son, Ltd.	Clydefield	Tanker	D. and W. Henderson and Co., Ltd.	420	57·5	32·8	6,000	One 8-cyl., 4-stroke, S.A., Harland-B. & W.	740	1,850	86	3,800	2,900	Electric and steam
Imperial Oil Co., Ltd., Canada	Victolite	11-knot tankers	Alex. Stephen and Sons, Ltd.	510	68	38	12,000	Two 6-cyl., 2-stroke, S.A., Krupp	680	1,300	92	4,200	3,500	Steam aux.
	Vancolite	,,	,, ,, ,,	510	68	38	12,000	Two 4-cyl., 2-stroke, S.A., Stephen-Sulzer	680	1,100	100	4,200	3,300	Steam aux.
King Line, Ltd.	Kings Arthur, Egbert, Neptune, Lud, John, William, Stephen	10-knot cargo	Harland and Wolff, Ltd.	400	55	34·66	5,224	One 6-cyl., 4-stroke, S.A., Harland-B. & W.	740	1,500	90	2,500	1,900	3, 60 kW
Lancashire Shipping Co., Ltd.	Greystoke Castle	14-knot cargo	Cammell Laird and Co., Ltd.	425	56	21·75	6,500	Two 6-cyl., 4-stroke, S.A., North-Eastern-Werkspoor	730	1,500	103	5,500	4,200	2, 100 kW 2, 65 kW
	Muncaster Castle	,,	,, ,, ,,											
Lawther Latta and Co., Ltd.	Anglo-Canadian	11-knot cargo	Short Bros., Ltd.	426	58	36·5	5,268	One 4-cyl., 2-stroke, opposed-piston Doxford	560	2,160	86	2,550	2,250	3, 80 kW
MacAndrews and Co., Ltd.	Pinto	12-knot cargo	Harland and Wolff, Ltd.	270·1	39·2	26·3	1,346	One 6-cyl., 4-stroke, S.A., Harland-B. & W.	630	1,500	115	2,495	1,750	Electric aux.
	Ponzano													
D. MacIver and Co., Ltd.	Brittany	12½-knot cargo	Arch. MacMillan and Son, Ltd.	400	55·2	38·3	4,772	One 8-cyl., 4-stroke, S.A., Harland-B. & W.	740	1,850	85	4,140	3,100	3, 100 kW
Moor Line, Ltd.	Glen Moor	10½-knot cargo	William Doxford and Sons, Ltd.	375	52	28	4,392	One 3-cyl., 2-stroke, opposed-piston Doxford	540	2,160	90	2,200	1,850	Steam aux.
	Innes Moor	,,	,, ,, ,,											
	Jed Moor	,,	,, ,, ,,											
	North Moor	,,	,, ,, ,,											
Navegaceo Costeira	Itanagé	14·7-knot pass.	William Beardmore and Co., Ltd.	370	52	26·75	4,966	Two 6-cyl., 4-stroke, supercharged Beardmore-Tosi	26	43½	137	4,780 supercharged	3,625	Steam aux.
	Itaquicé													
Nelson Lines, Ltd.	Highland Monarch	16½-knot pass.	Harland and Wolff, Ltd.	523·3	69·3	35·75	14,450	Two 8-cyl., 4-stroke, D.A., Harland-B. & W.	680	1,600	95	13,000	10,000	4, 200 kW
Oakway Steamship Co. Ltd.	East Lynn	10½-knot cargo	William Doxford and Sons, Ltd.	401·1	54·25	24·1	4,665	One 4-cyl., 2-stroke, opposed-piston Doxford	560	2,160	82	2,400	2,100	3, 65 kW
	West Lynn	,,	Napier and Miller, Ltd.	401·1	54·25	25·8	4,702	One 6-cyl., 4-stroke, S.A., Kincaid-B. & W.	740	1,500	89	3,100	2,500	3, 65 kW
Shaw, Savill and Albion, Ltd.	Zealandic	14½-knot cargo	Swan, Hunter and Wigham Richardson, Ltd.	481	64	42·8	8,281	Two 6-cyl., 2-stroke, S.A., Wallsend-Sulzer	31	43	115	9,300	7,450	4, 275 kW
	Coptic	,,	,, ,, ,,											
	Karamea	,,	Fairfield Shipbuilding and Engineering Co., Ltd.	481	64	42·5	8,281	Two 6-cyl., 2-stroke, S.A., Fairfield-Sulzer	31	43	115	9,300	7,450	4, 275 kW
	Taranaki	,,												
Capt. Christen Smith	Belmoira	10½-knot cargo	Armstrong, Whitworth & Co., Ltd.	325	49	23	3,214	One 4-cyl., 2-stroke, Armstrong-Sulzer	600	1,060	110	1,740	1,350	Steam and electric
	Belpamela	,,	,, ,, ,,											
United Molasses, Ltd.	Athelmonarch	14½-knot tankers	William Hamilton and Co. (1928), Ltd.	471·2	62·4	35·3	9,031	Two 6-cyl., 4-stroke, S.A., Kincaid-Harland-B. & W.	630	1,300	110	3,800	4,500	Steam
	Athelqueen	,,	Furness Shipbuilding Co., Ltd.	471·2	62·4	35·3	8,780	Two 8-cyl., 4-stroke, S.A., Kincaid-Harland-B. & W.	630	1,300	110	3 800	4,500	Steam
A/S Varild, Oslo	Athene	Tanker	Armstrong, Whitworth & Co., Ltd.	345·6	53·5	27·8	6,600	One 6-cyl., 2-stroke, S.A., Polar (Atlas Diesel Co.)	600	1,200	100	2,700	2,000	2, 45 kW

the "Highland Brigade," were launched, and by the middle of the present year all five ships will, it is expected, be commissioned.

Two interesting motor vessels are the 9000-ton cargo ships "Greystoke Castle" and "Muncaster Castle," built for the Lancashire Shipping Company, Ltd.—James Chambers and Co.—by Cammell Laird and Co., Ltd., and engined by the North-Eastern Marine Engineering Company, Ltd., with four-stroke machinery of the North-Eastern-Werkspoor type. A view of the "Muncaster Castle" is given in Fig. 3. On the Clyde, William Beardmore and Co., Ltd., finished two further ships for the Navegaçeo Costeiro, for South American coastal service. Another ship of the same type was delivered last year, and a similar motor vessel was finished in France during the year. A new design of six-cylinder Beardmore-Tosi engine was installed in the "Itanagé" and "Itaquincé," with a bore of 23in. and a stroke of 43½in. When running normally at a designed speed of 130 r.p.m., 1650 B.H.P. is developed, but an output of over 2000 S.H.P. for each engine was obtained with the engine running supercharged at a speed of 145 r.p.m. The combined inlet and outlet valve, of the Tosi pattern, working in conjunction with the director valve seem to be well adapted for a supercharged engine.

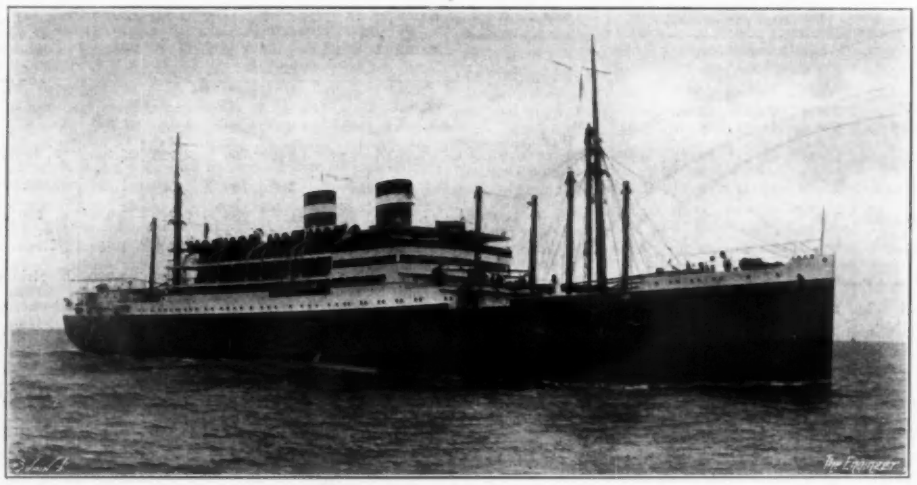


FIG. 2—THE GRACE LINER "SANTA BARBARA"

New Motor Tankers.

We have already made reference to the large proportion of oil tankers which figure in last year's returns. Outstanding among these ships are ten oil-carrying motor vessels, which were completed by various builders for British Tankers, Ltd., thereby finishing the building programme of thirteen ships. This order was a very welcome one, both on the Tyne and in Scotland, and it provided much work both for shipyards and engine shops. A tanker which was too small to be included in Table II. is the "British Thrift," a 185ft. ship of 700 gross tons, built by Swan, Hunter and Wigham Richardson, Ltd., and engined with Polar type two-stroke motors.

Among the larger tank ships we may single out the three 15,000-ton oil tankers for the Gulf Refining Company, of Pittsburg, which were built by the Furness Shipbuilding Company, Ltd., and equipped with Doxford opposed-piston balanced engines. At the same yard the large oil tanker "Calgarolite," for the Imperial Oil Company, of Toronto, was launched, and is being fitted out with Krupp two-stroke single-acting engines.

At the Linthouse Yard of Alexander Stephen and Sons, Ltd., two sister ships were constructed for the same Canadian owners. They are the vessels "Vancolite" and "Victolite," and they are propelled by Stephen-Sulzer and Krupp engines respectively.

An oil tanker of more than usual interest is illustrated in to-day's Supplement. She is the "Brunswick," constructed by Scott's Shipbuilding and Engineering Company, Ltd., for the Atlantic Refining Company, Ltd., of Philadelphia. A full description of this vessel, which is claimed to be the largest oil-electric ship afloat, was given in our issues of September 7th and 14th last. The design of the hull, which is somewhat original, the bridge being placed right aft over the machinery, and also of the propelling and auxiliary machinery equipment, was introduced by Mr. Lester M. Goldsmith, the owners' consulting engineer. The "Brunswick" has a deadweight carrying capacity of about 13,200 tons, and is propelled by a twin-armature British Thomson-Houston motor designed to develop 2800 S.H.P. The electric power is furnished by four 750 B.H.P. four-stroke airless injection engines of the Ingersoll-Rand type, built by Carels Frères, of Ghent, Belgium. They each have six cylinders with a bore of 19½in. and a stroke of 24in, and are designed to run at 225 r.p.m. The guaranteed fuel consumption is about 0·41 lb. per B.H.P. hour. The ship is controlled from the bridge by a B.T.H.-Sperry gyro pilot attachment, which operates the main switches, independent operation of the generator sets from the engine-room being provided for. The "Brunswick" is also a noteworthy vessel in as much as her total auxiliary power when at sea is not more than 1¼ per cent. of her main propelling power. The use of standardised land-type non-reversible engines and standard electrical equipment enabled the ship to be built at a cost which did not exceed that of a direct-driven motor tanker designed to carry the same amount of cargo. The new tanker is reported to be one of the most efficient and economical vessels of its kind at sea, and the daily fuel consumption is stated to be somewhere in the neighbourhood of 12 tons.

The other tankers for British ownership are the "Chesapeake" and "Schuylkill," built for the Anglo-American Oil Company, Ltd.; one of them is propelled by Workman-Sulzer engines, and in the other Doxford machinery was installed. Two further additions were made to the fleet of molasses tankers, owned by the British Molasses Company, Ltd., in the ships "Athelqueen" and "Athelmonarch," and a third ship, the "Athelduke," is nearing completion; in all three vessels engines of the Kincaid-Harland four-stroke type were installed. Several other smaller tankers were built for British and Scandinavian owners, particulars of which are given in Table II. on page 7.

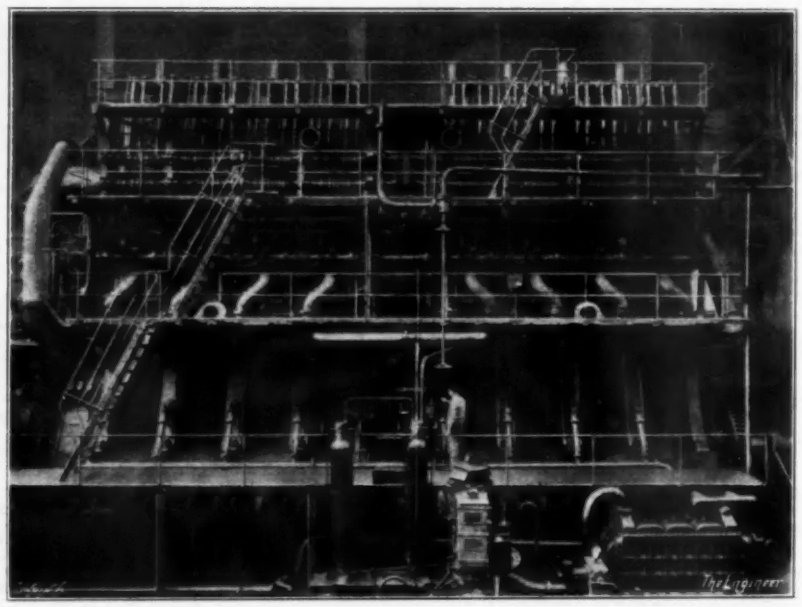


FIG. 4—5000 S.H.P. KINCAID-HARLAND-B AND W D.A. FOUR-STROKE ENGINE

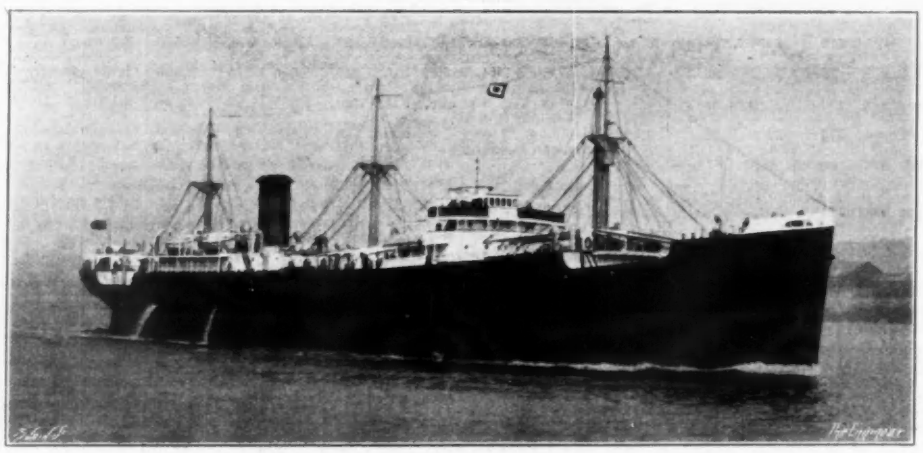


FIG. 3—THE MOTOR CARGO SHIP "MUNCASTER CASTLE"

Types of Propelling Machinery.

The Four-stroke Single-acting Type.—A glance at the list of ships finished during the year will show a preponderance of engines of the four-stroke single-acting type, which type was shown by Mr. Sterry B. Freeman in his paper on "Marine Oil Engines," given before the Diesel Users Association in October—see THE ENGINEER of October 19th—to have proved most economical as regards fuel and lubricating oil costs and repairs for the smaller and medium powers. With the addition of exhaust-turbo supercharging increased powers can be obtained. The leading type of engine was the Harland-B and W pattern, which was manufactured at Belfast and Glasgow, also at Greenock in the works of J. G. Kincaid and Co., Ltd. In some engines a longer stroke was used, and trunk pattern engines were also employed. The engines for the three new cross-channel vessels for the Belfast-Liverpool service, which are being constructed by Harland and Wolff, and upon which work is well advanced, will be of the twin-screw ten-cylinder trunk-piston type, operating with airless injection, and it is understood that quadruple screw machinery of the same type will be employed in the new liner ordered for the Pacific Steam Navigation Company, Ltd. This decision was come to as the result of the excellent service given by airless injection engines in the same company's cargo vessel "Lautaro," which have now been in commission for over two years.

At Wallsend the North-Eastern Marine Company

built engines of the four-stroke single-acting Werkspoor type, and some interesting work was done by this firm in fitting Büchi exhaust-turbo supercharging to the eight-cylinder 3000 I.H.P. engine installed in the "Raby Castle." An increase of 1 knot in the ship's speed was obtained, and the engine was shown to be able to develop very large increases of power when supercharged by the Brown-Boveri exhaust gas turbine-driven blower fitted in the exhaust main. This first ship will be followed by other vessels, and one of them will be the reconstructed "Lochmonar" with a new forward end. An able account of the very interesting

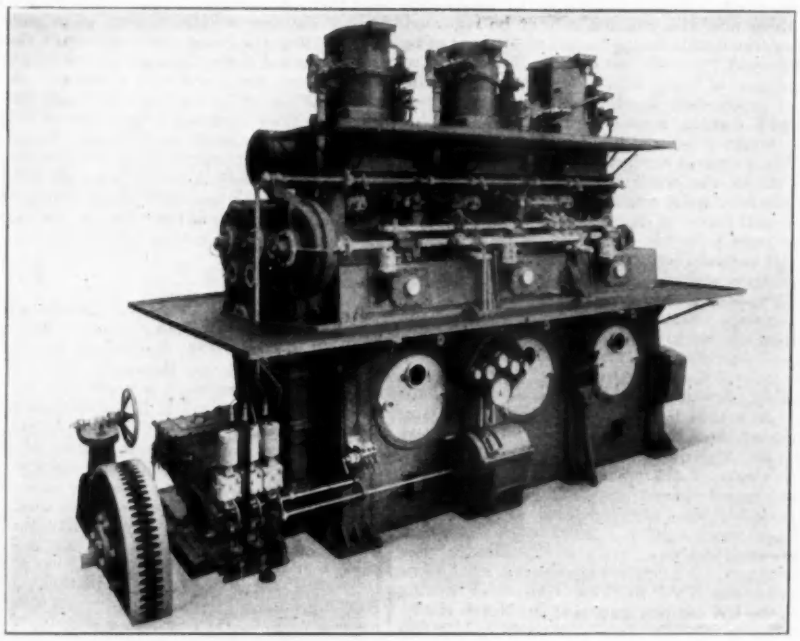


FIG. 5—630 S.H.P. DOXFORD TWO-STROKE OPPOSED-PISTON ENGINE

salvage and reconstruction of this vessel was given before the Belfast Association of Engineers in December, by Mr. James Harney.

An interesting departure from hitherto accepted practice was made by Mr. Sterry B. Freeman, of Alfred Holt and Co., who ordered toward the close of the year machinery for several motor vessels, which will be built by Scott's and the North-Eastern Marine Company, to the owners' specification and design. The engines are to be of the four-stroke single-acting type, working with exhaust-turbo supercharging.

Four-stroke Double-acting Motors.—The lead established by the four-stroke double-acting engine of the Harland-B and W type was maintained, and as will be seen from Table II. several ships were so fitted. To the Clan Line, Ltd., belongs the honour of possessing the first single screw ship engined with this type of machinery. It was built by the Greenock Dockyard Company, Ltd., and engined by J. G. Kincaid, Ltd. A view of the main engines is reproduced in Fig. 4, and the dimensions are given in Table II.

The general design follows closely that adopted by Harland and Wolff, Ltd, in the Elder Dempster liners "Apapa" and "Accra," in which six-cylinder units are employed. As will be seen from Fig. 4, the two air compressors are arranged at the forward end of the engine. The variable lift system for the fuel valves is fitted, and the cam shafts are driven by a chain from the crank shaft. Altogether four sets of engines were constructed by Messrs. Kincaid, two sets for the two Clan liners "Clan Macdonald" and "Clan Macdougall," and two for the new Prince Line motor vessel "Northern Prince," which is now fitting out. All these engines have a bore of 680 mm. with a stroke of 1400 mm.

In THE ENGINEER of February 10th we referred to the successful operating results obtained with the Werkspoor double-acting four-stroke engine fitted with Lugt-Zulver valve gear. This type of engine was installed in ten tankers belonging to the Anglo-Saxon Petroleum Company, Ltd., and it has, we are informed, given most satisfactory results, both as regards economical running and maintenance.

Single-acting Two-stroke Engines.—There was a remarkable increase in the number of two-stroke single-acting engines built during the year, particularly those of the Sulzer type. We have already referred to the series of vessels engined by the Fairfield and Wallsend Slipway Companies with machinery of this type. By Armstrong, Whitworth and Co., Ltd., several sets of engines were built, some of which were installed in the two locomotive-carrying motor ships "Belmora" and "Belpamela," built to the order of Captain Christen Smith. The largest Sulzer type motors built in this country were those constructed by John Brown and Co., Ltd., at Clydebank, for the two 16,000-ton twin-screw motor vessels of the New Zealand Shipping Company, Ltd., which will be completed early in this year. They are five-cylinder units with a cylinder bore of 900 mm., or about 35in., and stroke of 1600 mm. They are designed to give a total output of about 10,000 S.H.P. at 95 r.p.m. Auxiliary engines of the Weir-Sulzer type will be fitted.

Other types of two-stroke marine oil engines built and installed during the year included several sets of Gardner oil engines, and a new type of cold starting high compression Gardner engine was introduced. It will be built in a range from 50 up to 500 B.H.P. engines. Gardner engines were installed in the Southern Railway Company's Isle of Wight motor car ferry "Wooton," which was constructed by William Denny and Bros., Ltd. Several sets of machinery were built by Petters, Ltd., of Yeovil. A new type of Petter oil engine for a motor boat was described in THE ENGINEER of August 24th. Swan, Hunter and Wigham-Richardson, Ltd., completed several sets of two-stroke single-acting engines of the Polar type under licence; and Worthington, Simpson and Co., Ltd., of Newark, built one or two sets of marine type oil engines.

Two-stroke Opposed-Piston Engines.—One of the most marked features of motor ship construction is the increase in the number of Doxford opposed-piston engines. As will be readily seen from Table II, no less than eighteen sets of machinery have been constructed by William Doxford and Sons, Ltd., and the firm's licencees. We show in Fig. 5 a new type of Doxford engine which opens a fresh field for both auxiliary and propelling work. It is designed to develop 650 S.H.P. at 125 r.p.m. in three working cylinders, and was installed in the oil tanker "Freshmoor." As in the "Bermuda" engines and other sets of recent construction, the two piston strokes are unequal, the upper one being 540 mm. and the lower 760 mm., with a cylinder diameter of 400 mm. Such an arrangement gives a well balanced engine. The cam shafts are driven by spur gears, which are arranged at the fly-wheel end of the engine, just above platform level. The controls are grouped at mid-engine position, and the fuel pump unit is neatly arranged at one end. All auxiliary pumps are lever driven, so that when at sea the engine is independent of other auxiliary machinery. The weight of the engine is comparatively small, and its height can be altered in the case of auxiliary units where small head room

FIG. 6—1250 S.H.P. D.A. RICHARDSONS-WESTGARTH ENGINE

is required. Towards the end of the year Mr. K. O. Keller, Messrs. Doxford's chief engineer, read an interesting paper before the North-East Coast Institution of Engineers and Shipbuilders, in which he dealt with some of the difficulties attending the burning of oil fuel in engine cylinders. He stated that the progress made in ten years' development of the Doxford engine had now reduced the fuel consumption down to 0·34 lb. per B.H.P. hour, a figure which

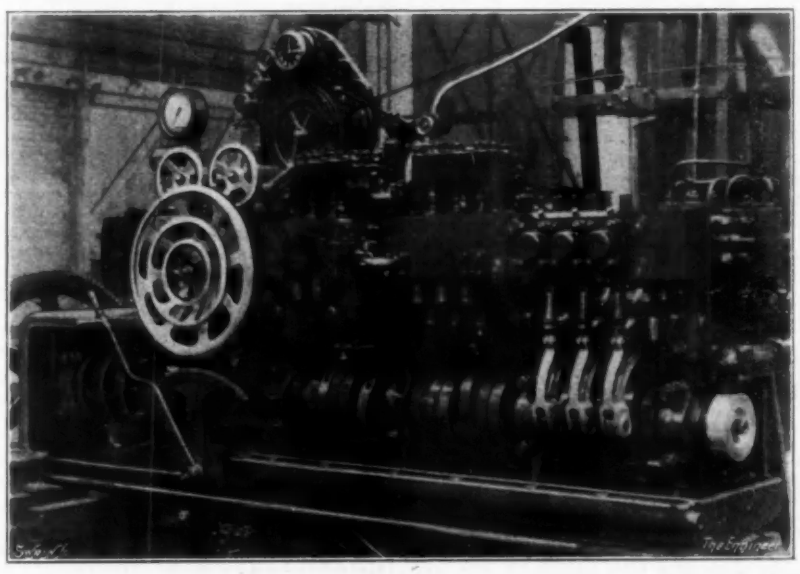


FIG. 7—FUEL PUMP AND STARTING CONTROLS—RICHARDSONS-WESTGARTH ENGINE

left, he said, comparatively little scope for a further improvement.

Two-stroke Double-acting Engines.—One of the interesting new engines of 1928 was the three-cylinder airless-injection double-acting two-stroke motor built by Richardsons, Westgarth and Co., Ltd., for the oil tanker "Irania," belonging to the Iranian Tanker Company, Ltd., of London, which vessel was launched in December by the Blythswood Shipbuilding Company, Ltd., at Scotstoun. A view of the new engine is reproduced in Fig. 6. In general design it follows closely the experimental single-cylinder unit referred to in last year's annual article.

The bed-plate and framing has been stiffened, and attention has been given to the cooling of the cylinder casing, the fuel valves, and the delivery of the scavenge air to the cylinders. Each of the three cylinders has a bore of 21½in., with a stroke of 38in., and the unit has a designed output of about 1200 S.H.P. when running at a speed of round about 89 r.p.m. A feature of the design is the provision of a rotary scavenge pump driven at three times the engine speed. Mechanically-operated valves allow for timed delivery of the scavenge air. As will be seen from Fig. 6, the scavenge pump is mounted at the after end of the engine, and is driven from the crank shaft. It can be motor driven if desired. The fuel pump unit is shown in Fig. 7. It is self contained and is bolted to the engine on the front side. For the shop tests this unit was separately driven by a special electric motor, and we gather that some interesting results were obtained. In designing this new engine great attention was paid to the production of standard cylinder units, which can be readily and cheaply manufactured and built up into different standard units embracing a wide range of horse-power. The trials of the new engine will shortly be completed.

At Barrow-in-Furness Vickers-Armstrongs, Ltd., completed two sets of Vickers-M.A.N. 4000 B.H.P. four-cylinder engines, with a cylinder bore of 27·6in., and a stroke of 47·25, designed to work at 115 r.p.m. As regards the general design, these two engines, which were constructed to meet Admiralty practice for the submarine repair and depôt ship H.M.S. "Medway," follow closely the M.A.N. type of engine built at Augsburg for the "Rameses." A description of the "Medway" engines was given in THE ENGINEER of August 31st last. In the new engines of this type a slightly different construction of cylinder casing and cover will be adopted and airless injection will most likely be employed.

The Scott-Still Marine Oil Engine.—An outstanding motor ship of 1928 was the Hall Line motor vessel "Eurybates," which was built and engined by Scott's Shipbuilding and Engineering Company, Ltd., of Greenock. A view of the vessel itself is given in to-day's Supplement, and particulars of the hull and propelling machinery will be found in Table II. on page 7. A very full account of the machinery installation of this vessel was given in our issue of March 30th. The arrangement of the internal combustion and steam cylinders differs from that of the "Dolius," in that the five combustion cylinders and two steam cylinders drive separate cranks, making a seven-cylinder engine. By means of a well-arranged series of auxiliaries, very good use is made of the waste heat from the cylinder casings, covers and exhausts. We are given to understand that the engines have continued to run well and economically. In the course of the year a new firm, entitled Plenty Still Oil Engines, Ltd., was formed to take over the oil engine work and the King's-road Works of Plenty and Son, Ltd. One set of Plenty-Still engines was installed in the motor drifter "Larus," and some sea experience was gained.

Electrically Propelled Motor Vessels.—We have already referred to the world's largest oil-electric tanker "Brunswick," which was constructed by Scott's Shipbuilding and Engineering Company, Ltd., at Greenock, for the Atlantic Refining Company of Philadelphia. Another electrically propelled ship was built on the Clyde by Yarrow and Co., Ltd., at Scotstoun, for the river Parana ferry service of the Argentine Ministry of Public Works. It is a 145ft. vessel with a breadth of 45ft. at the deck. There are two decks and the vessel is equipped with twin screws at either end, which can be electrically controlled from the bridge. The propelling motors and generators were supplied by the Metropolitan-Vickers Electrical Company, Ltd., and the two engines driving the generators are of the M.A.N. four-stroke airless injection type.

(To be continued.)

Electrical Engineering in 1928.

No. I.

WHILE 1927 was a record year in the expansion of electricity supply in this country, available records indicate that during the period under review—1928—progress was less satisfactory. According to the "Trade Survey" issued by the Beama, in the first quarter of 1928 an improvement of 10 per cent. over the corresponding period of 1927 took place, but afterwards there was a marked tendency for advance to slow down until, in the quarter ending October, it was not much more than 6 per cent. A statement issued by the Beama on October 10th dealt with movements in the production of electricity over the main industrial areas during the first eight months of the year, and showed that in the first three months, the South-West Midlands and the Mersey and West Lancashire areas were the most active, the rate of increase being 19 per cent. over the previous year. After March, however, trade depression became a damping factor in the first of these areas, with the result that in the quarter ending October the increased consumption fell to 6 per cent. But the returns for October show that in the Birmingham area there was considerable recovery. The annual average rate of increase was reached in that month, so that the trade depression may be considered to have affected that area over the six months, April to September. A similar movement occurred in the Mersey Estuary, but with a much less marked decline during the summer and early autumn months. The improvement recorded in September and October, however, brought the rate of increase during the last quarter up to 10 per cent. An examination of movements in all of the industrial areas confirms the opinion that during the six months, April to September, a very severe industrial depression reigned in practically every part of the country, with the possible exception of the West of Scotland, and that this depression was translated into a sub-normal demand for electrical energy. Even now the position cannot be regarded as very rosy, for textile and iron and steel areas have not yet emerged from the depression and there are few indications of very rapid improvement. The recovery of production which took place in October only affected certain areas, notably the West of Scotland, South-West Midlands, and the West Riding. With several exceptions, states the "Trade Survey," where the work carried out by supply engineers has been quite remarkable, there is no widespread national policy of domestic electrification, and until some such policy is operative the fluctuations in industrial activity will be translated at once into fluctuations in power supply activity.

The total capacity of plant placed on order in this country during the first nine months of the year was slightly over 400,000 kilowatts, and owing to certain very large contracts of a special nature, industry accounted for almost 35 per cent. of this total. Figures kindly supplied to us by the Electricity Commissioners show that the plant installed by company and municipal undertakers at the end of the year 1927–1928, *i.e.*, December 31st, 1927, to March, 1928, was approximately 5,277,000 kilowatts. The number of stations opened since March 31st, 1928, was five, and the number shut down seven. The "Trade Survey" estimates that the total capacity of all generating plant in this country at the present time, including industry, is 8,000,000 kilowatts. Among the new stations described in THE ENGINEER during 1928, were the Brimsdown station of the North Metropolitan Electric Power Supply Company (50,000 kilowatts); the Coventry Corporation's Longford power station (40,000 kilowatts), and the Woodbridge-road station of the Guildford Corporation (6000 kilowatts). These three stations are illustrated in a Supplement published in this issue, as is also the new 40,000-kilowatt set which has recently been added to the Barton station of the Manchester Corporation. The No 3 Lister-drive station of the Liverpool Corporation, which we also described very fully, was set to work in 1926, but some new and interesting boiler plant is now in the course of erection.

For the purpose of comparison, the statistical department of the Beama has investigated the fuel consumption and thermal efficiencies of twenty-five of the most efficient stations in Britain from 1922 onwards. Each year, without intermission, there has been a steady improvement which has been partly attributable to the installation in existing stations of new generating plant manufactured in this country, and partly to the completion of new stations equipped by British firms. During the six years the overall thermal efficiency of the twenty-five stations rose from 15·35 per cent. to 18·7 per cent., while the fuel consumption per unit generated fell from 2·05 lb. of coal to 1·68 lb., a reduction of over 18 per cent. The returns for 1927–28 show that out of the twenty-five stations no less than fourteen belong wholly to the post-war decade, whilst in the remaining eleven stations the load is taken by plant installed since the conclusion of the war. The average efficiency achieved, *i.e.*, 18·7 per cent., compares with the best results obtained in similar American and continental power stations. Yet among these stations there are only three that enter into the super-power category—namely, Barton, North Tees, and Barking. The following table, which is from the "Trade Survey," gives particulars of six stations which are in the first rank from the point of view of efficiency of the generating stations of the world. To the list should be added the North Tees station, with an overall efficiency of 20·49 and the Barking station with an overall efficiency during its most favourable month of 20·64 per cent. Here we have eight stations, which compare with the best that American and continental practice has hitherto produced

Station.	Month.	Units generated, units.	Maximum demand, kilowatts.	Load factor, per cent.	Fuel consumption per unit generated, lb. of coal.	Thermal efficiency, per cent.
Barton (Manchester)	February (1928)	28,418,200	62,360	65·47	1·35	21·80
Padiham (Lancashire Power Co.)	March (1928)	6,214,470	12,500	65·66	1·33	21·34
Agecroft (Salford)	January (1928)	7,148,544	24,500	40·0	1·51	20·46
Lister-drive No. 3 (Liverpool)	April–September (1928)	54,173,017	26,500	50·80	1·39	20·20
Grove-road (London Power Co.)	December (1927)	25,930,170	79,100	44·10	1·55	20·15
Clyde's Mill (Clyde Valley Electrical Power Co.) ..	September (1926)	7,558,031	17,800	59·01	1·61	19·05

The Padiham, Agecroft and Lister-drive stations are the most interesting. The results indicated in the case of Padiham were obtained with two 7500-kilowatt generating sets. There is an additional set of 15,625 kilowatts, but as it was not in operation during the year in question, results were obtained with an effective operating capacity of 15,000 kilowatts, superior to those recorded in the Calumet or Crawford-avenue stations of the Commonwealth Edison Company of Chicago, with a total installed capacity of over 300,000 kilowatts and with generating sets ranging from 50,000 to 88,000 kilowatts. The Salford results are also admirable, for this station is equipped with three turbo-alternators, 10,000-kilowatt economical load, with a maximum continuous rating of 12,500 kilowatts. The station takes the entire load of the city of Salford, with all its severe fluctuations during the year, with the result that the load factor reached during its most active months was only 40 per cent., compared with 65·66 per cent. at Padiham. When it is remembered that the Padiham station was equipped at a total cost of little over £12 per kilowatt installed, that the new Longford station of the Coventry Corporation involved a similar capital expenditure, while Agecroft with all extensions has not exceeded £18 per kilowatt, it is seen that British engineers are building the cheapest and most efficient generating stations in the world.

Electricity Schemes.

Three important electricity schemes were adopted by the Central Electricity Board. The South-East England scheme, 1927, published by the Board in its adopted form on February 17th, 1928, covers 8828 square miles, with a population of 11,392,561, and embraces the areas of 165 authorised undertakers, owning collectively 135 public supply stations. The area includes the electricity district of the London and Home Counties Joint Electricity Authority. The number of existing stations that have been selected under the scheme is thirty-one. Four new capital stations of varying capacity up to 360,000 kilowatts, are to be erected. During the transitional period, eight further existing stations at Colchester, Guildford, Hastings, Kingston-upon-Thames, Poplar, Reading, Tunbridge Wells, and Watford may be operated for the Board under a temporary arrangements clause. The main overhead transmission lines will be of the same capacity as those for the Central Scotland scheme, and, generally speaking, the secondary transmission lines will be operated at a pressure of 33,000 volts. At various points there will be transforming stations working in connection with the primary and secondary transmission systems.

The Central England Electricity Scheme, 1928, published by the Board in its adopted form on March 31st, covers an area of 7311 square miles, with a population of 5,218,146, and comprises the whole or a large part of the area of forty-nine authorised undertakers. It includes the West Midlands, the South-West Midlands, and the East Midlands electricity districts, and the electricity district, so far only provisionally determined, of the North-West Midlands. Under the scheme it is proposed to utilise as selected stations nineteen of the forty-six generating stations in operation or authorised in the area, and to erect a new capital station with an ultimate capacity of 200,000 kilowatts at Ironbridge. Five more stations at Birmingham, Kettering, Coventry, Loughborough, and Stafford, may be operated for the Central Board during the transitional period under a temporary arrangements clause. The selected stations will be interconnected by 132,000-volt lines, and the secondary transmission lines will be operated at 33,000 volts. A change from the frequency of 25 cycles per second to 50 cycles will have to be made in certain localities, and five undertakings will be affected by the change, notably those of the Birmingham Corporation and the Shropshire, Worcester and Staffordshire Electric Power Company.

The North-West England and North Wales Electricity Scheme, 1928, published in its adopted form on October 23rd, comprises an area of 9082 square miles and a population of 6,980,025. It extends from the Scottish border to the county of Radnor and the southern boundary of the Central England scheme in the south and stretches from the coast of Wales in the west to Northumberland, Durham and Yorkshire in the east. It includes the densely populated industrial area of Lancashire, as well as extensive sparsely inhabited country, principally in the northern part of the area, most of which is at present without any system of electricity supply. The scheme includes the area of supply of 122 authorised undertakers,

and the electricity districts of South-East Lancashire, Mid-Lancashire, and North Wales and South Cheshire. Out of a total of seventy public generating stations, twenty-seven have been selected, and to them will be added two new stations to be erected at Manchester and Liverpool respectively. As in the other schemes, the main transmission scheme is to be designed to give alternative routes, so as to provide security against breakdown, and it will extend over about 384 square miles. There will be twenty-nine transforming stations in connection with the main transmission system, and twenty-four stations will be associated with the 33,000-volt lines. The scheme provides for the standardisation of frequency in the area of one of the undertakings.

For the Central Scotland scheme, all the principal contracts have been placed, and the erection of the Helsby towers—see Fig. 1—has been begun. In connection with the other schemes important contracts have also been placed. The value, so far, of the contracts for transmission lines is approximately £1,400,000, for secondary lines £50,000, for primary transforming stations £1,250,000, and for secondary transforming stations £83,000.

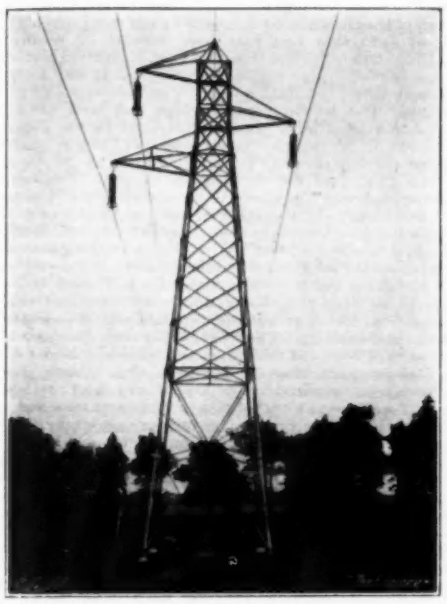


FIG. 1—132,000-VOLT TRANSMISSION LINE

Rural Electrification.

The revision of the Electricity Commissioners' rules governing overhead line distribution was an important event from the point of view of electro-farming. Notable work was carried out by the Overhead Lines Association, which drafted a standard wayleave form, the adoption of which should clear up many contentious points. The publication of the Electricity Commissioners' "Report of Proceedings of the Conference on Electricity Supply in Rural Areas," aroused considerable interest, not only because it gave the number of British farms connected to public supplies as over 2000, but also because of the data it contained and its recommendation that supply undertakers should be urged to extend their mains into rural areas. According to Mr. Borlase Matthews, who is the recognised authority on electro-farming in this country, electro-farming machinery manufacture is proceeding steadily, though slowly, along clearly defined lines. Judging by the machinery shown at the Paris Agricultural Machinery Exhibition last January and by what has been exhibited at British Shows, one job for one motor seems to be the requirement of experienced farmers. Incidentally, electrically operated farm machinery was exhibited at all the leading agricultural shows, such as the Royal, the Three Counties, and the Dairy Show, &c. At the Royal Show it was noticed that, in the dairy section alone, 109 electric motors were being employed. A Silver Medal award—the most coveted prize of the year—was made for an ingenious poultry-plucking machine, by means of which a bird can be plucked in a few minutes. At the Dairy Show, an exceptionally large number of electric motors were to be seen, and an outstanding feature was the refrigerating plant for farms, but, in general, this plant is not sufficiently serviceable or low enough in price. The prejudice against the rotary cultivator is generally disappearing; at any rate, that is the opinion of Mr. Borlase Matthews, who read a paper on electric ploughing before the Institution of Electrical Engineers. A cheap form of overhead line construction that is being tested at Mr. Matthews' farm at East Grinstead, appears to have much to recommend it, and for 6600-volt operation the cost is under £70 per mile.

What Mr. S. E. Britton has done at Chester was described in our issue of June 15th, and a view of part of the overhead line work which has been erected in accordance with the Commissioners' revised rules is shown in Fig. 2. There are now fifty-five farms under observation, giving an annual load of 100,775 units, at an average selling price of 2·48d. per unit, which works out at just over 13 units to the acre. This, of course, is very low compared with continental practice, but the consumption will no doubt increase in due course. Thrashing tests carried out in the area are said to have resulted in a 50 per cent. reduction in the cost, as compared with that of steam. Good progress was made in Mid-Cheshire, Ayr, Somerset and Fife. A few weeks ago Lincoln was the centre of electrical enthusiasm, when Colonel T. C. Ekin presided over an inquiry into six schemes put forward by various concerns for the electrification of parts and the whole of Lincolnshire. The result of the inquiry is not yet known. One of the applications made was for extensive agricultural areas covering over 1800 square miles, or about 3 per cent. of country that is not at present covered by any existing electricity supply authority.

FIG. 2—OVERHEAD DISTRIBUTION AT CHESTER

Turbo-Generator Sets.

Of the turbo-generators under construction in various works, one of the most interesting is a 10,000-kilowatt B.T.H. set, designed for a speed of 3600 revolutions per minute, a steam pressure of 365 lb. per square inch gauge, a total temperature of 1000 deg. Fah., and a vacuum of 29in. Three-point extraction will give a final feed water temperature from the last heater of 312 deg. Fah. at 8000 kilowatts. So far as the utilisation of high temperatures is concerned, the turbine marks the latest development, for the temperature of 1000 deg. Fah. is the highest so far attempted anywhere. Two-cylinder impulse reaction turbines, running at 3000 revolutions per minute, were included in the development work of this firm. Two 20,000-kilowatt sets of this type—shown in our Supplement—were built for the Longford power station of the Coventry Corporation. Other similar sets are in the course of construction. Two 25,000-kilowatt machines for the new Kirkstall power station of the Leeds Corporation are designed for maximum initial steam conditions of 500 lb. per square inch gauge and 750 deg. Fah. total temperature. Like the other two-cylinder machines, the turbines of these sets have impulse blading in the high-pressure cylinders, and double-flow reaction blading in the low-pressure cylinders. An interesting 3000-revolution per minute, single-cylinder machine under construction in the Rugby works, is rated at 12,980 kilowatts. It is to operate with steam at a pressure of 500 lb. per square inch gauge, 790 deg. Fah. total temperature and a vacuum of 28½in., at the economical load of 20,464 kilowatts. For the new Kearsley power station of the Lancashire Electric Power Company the B.T.H. Company is constructing two two-cylinder 32,000-kilowatt sets designed for a speed of 1500 r.p.m. The low-pressure end will be of the single flow type, and impulse blading is being employed throughout. For considerably higher ratings, say, 50,000 to 75,000 kilowatts, B.T.H. machines of this type have a double-flow low-pressure end, and the 67,200-kilowatt machine which this firm is about to build for the Battersea power station of the London Power Company will be constructed on these lines. A 20,000-kW, two-cylinder machine made at Rugby during the year is to be installed in the new power station of the Japanese Imperial Government Railways.

The electrical machines of the B.T.H. large sets are now generally provided with a ventilating fan mounted in a separate casing. Bed-plates and stator frames of the B.T.H. alternators are in these days generally built up on the fabricated principle, with mild steel plates—as shown in Fig. 3—and casings are seldom employed. Another electrical development was the adoption of the principle of separately-excited exciters, which ensures electrical stability and quick response to sudden changes in load. Separately-excited exciters are available for alternators with outputs down to 6000 kilowatts. Existing machines have been re-equipped with these exciters, and with modification to their voltage regulators, have given very satisfactory results on power systems subject to frequent feeder faults. Turbo-alternators were manufactured for special high-frequency work, and machines rated as low as 1500 kilowatts and wound for 11,000 volts were put into service during the period under review. Improvements in the steels available for the steam and electrical ends of turbo-alternators have made the manufacture of still larger high-speed machines practicable. Although the ultimate size is still a matter of doubt, it is thought that even 50,000-kilowatt sets running at 3000 revolutions per minute, and 120,000-kilowatt sets working at 1500 revolutions per minute, may not represent the upper limits.

The English Electric Company developed 3000-revolution per minute multi-cylinder steam turbines in sizes up to 40,000 kilowatts. Two 30,000-kilowatt machines will be put into service about the middle of 1929, one for the county borough of West Ham and the other for the Valley-road power station of the Bradford Corporation. The West Ham set, will drive a two-phase English Electric alternator. Three 23,400-kilowatt sets are being built by this firm for the Banhida power station of the Hungarian Power Supply and Railway Electrification scheme, and a 25,000-kilowatt unit for the Leicester Corporation. All these sets will run at a speed of 3000 revolutions per minute, and a high-pressure turbine of the impulse type with built-up diaphragms will pass steam to low-pressure units of the reaction type.

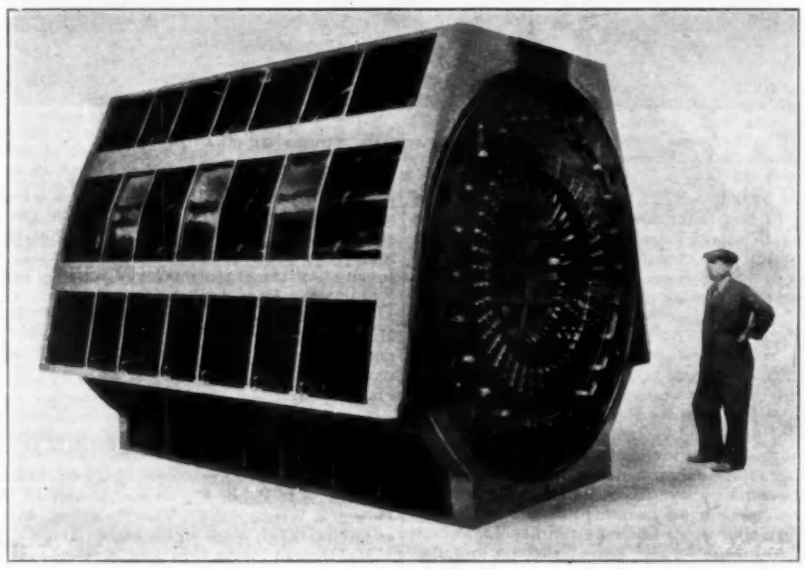


FIG. 3—FABRICATED STATOR—B.T.H.

The Battersea Corporation placed an order with the General Electric Company for 40,000-kVA (0·8 power factor) set, which is claimed to be the largest unit designed for 3000 revolutions per minute put in hand in this country. Orders from overseas obtained by the General Electric Company indicate

the confidence which municipalities and industrial undertakings in distant parts have in British manufacture. The firm built sets for Adelaide, Johannesburg, Pretoria, Kuala Lumpur, Canada, and for a prominent Australian mining company. All these machines were designed for 3000 revolutions per minute, the first having an output of over 20,000 kilowatts, and those for Johannesburg and Kuala Lumpur over 10,000 kVA.

The largest power unit so far installed in Britain is the 41,000-kilowatt, 1500-revolution per minute, Metrovick machine, illustrated in our Supplement, and installed in the Barton power station of the Manchester Corporation. Larger sets have, however, been ordered from the Metropolitan-Vickers Electrical Company for the Portishead power station of the Bristol Corporation and for the Battersea station of the London Power Company. The Bristol set is to develop 51,250 kilowatts. The alternator will have a capacity of 62,500 kVA, whilst the Battersea alternator will have a capacity of 80,000 kVA, the speed being 1500 r.p.m. in each case. A noteworthy feature of this firm's large machines is that a house service set is often directly coupled to the main alternator.

The Bristol contract was one of the most important of the year, covering as it does the complete equipment for the second stage of development of the Portishead station. The first stage of the development, for which the Metropolitan-Vickers Electrical Company is also the main contractor, and which includes the installation of two 20,000-kilowatt turbo-alternator sets, is rapidly approaching completion. Eight turbo-alternator sets with a total capacity of over 80,000 kilowatts are being built by the firm for a large works of Imperial Chemical Industries, Ltd., near Stockton-on-Tees. Self-contained sets for alternating or direct-current generation for medium and small capacities were developed during the year—see THE ENGINEER, October 5th, 1928. At present, these sets are made in sizes ranging from 300 to 3750 kilowatts. During the short time they have been available, over forty sets have been ordered, twenty-three of which are for the Admiralty. A high-speed turbine, working in conjunction with gearing, drives a slow-speed generator, and all the auxiliaries are compactly arranged and are driven direct from the set.

The outstanding feature of the work of C. A. Parsons, Ltd., was the completion and setting to work of the 33,000-volt, 25,000-kilowatt set—Fig. 4—installed in the Brimsdown station of the North Metropolitan Electric Power Company, described in THE ENGINEER of November 30th, 1928 and illustrated in our Supplement published in this issue. The set was put to work on the commercial load on August 16th, 1928, since which it has operated with perfect satisfaction at its maximum capacity and at pressures varying between 34,000 and 34,500 volts. Like the other tandem 25,000-kilowatt Parsons turbo-generator in this new station, this 33,000-volt unit runs at a speed of 3000 revolutions per minute. The output of the firm's tandem sets running at this speed has been considerably increased by an arrangement providing greater exhaust area. Parsons steam turbines for rope pulley drives in mills continue to increase in size. For an Indian jute mill the firm is constructing a 5000 brake horse-power machine, which is believed to be the largest geared turbine intended for work of this nature. It is being built on the reaction principle throughout, with the high and low-pressure cylinders arranged side by side and coupled through single-speed reduction gearing to the rope drive of the mill. The efficiency of the Parsons moderate size turbines continues to improve. Official tests carried out early in the year by an independent testing staff on two 5000-kilowatt, 3000-revolution machines installed in this country, are said to have shown a remarkably good efficiency at the turbine coupling from stop valve pressure to vacuum. Tests were also made on a 16,000-kilowatt, 3000-revolution machine installed in the White Bay power station, Australia, by the Railway Department's officers.

(To be continued.)

FIG. 4—33,000 VOLT PARSONS TURBO-GENERATOR

Obituary.

ALEXANDER THOMAS HOLLINGSWORTH.

IT is with great regret that we have to put on record the death of Mr. A. T. Hollingsworth, which took place at his home in Hampstead on Monday last, December 31st. Mr. Hollingsworth, who had very nearly completed his eighty-second year, had for very many years been closely associated with our contemporary *Engineering*, in the development of which he had played a leading part.

Alexander Thomas Hollingsworth was born in Birmingham, and was educated at King Edward VI. Grammar School in that city and at West's Academy at Amersham. In 1865, when eighteen years of age, he was sent by his father to Paris to learn French, and, while there, he was, for part of the time, in the employment of a firm which was engaged in the silk and cloth trade. In 1866, when his father died, young Hollingsworth was drafted to the London office of that firm, and some two or three years later he entered the service of a firm of accountants.

In 1870 he married the eldest daughter of the late William D. Allen, of Sheffield. Mrs. Hollingsworth, who survives him, was the niece of Sir Henry Bessemer, and, consequently, the two men became intimately acquainted. Sir Henry had been instrumental in enabling Mr. Zerah Colburn to start *Engineering* as proprietor and first editor in 1866, and the latter had, as his assistants, two young engineers, the late Mr (afterwards Dr.) W. H. Maw and the late Mr. James Dredge. Shortly after Bessemer and Hollingsworth came together, Colburn, who was of an erratic temperament, tiring of the work he had undertaken, desired to sell the Paper, and it was suggested to Hollingsworth by Sir Henry that he should buy it, which he did. Apparently, the relations between Messrs. Maw and Dredge and the new proprietor were, at first, somewhat strained, but, before long, Hollingsworth's charming personality, added to the business ability which he possessed to a high degree, entirely won the confidence and respect of the two young men, who were eventually taken into partnership. The three laboured harmoniously and strenuously together, and succeeded in raising the Publication from what was then a comparatively struggling existence to the position which it finally attained as a scientific technical journal. Mr. Dredge died over twenty years ago and Dr. Maw died in 1924, so that for the last four years or so Mr. Hollingsworth remained the sole survivor of the three men who may be said to have "built up" *Engineering*.

In addition to his connection with our contemporary Mr. Hollingsworth was a director of A. and F. Pears, and Chairman of the London Colour Printing Company, as well as of Weldon's, Ltd., and of Addressograph, Ltd.

COLONEL HAROLD PERCY DOW.

THE death is announced of Lieut.-Colonel H. P. Dow, A.M.I. Mech. E., senior partner in the firm of Dow and Wilson, of 32, Victoria-street, Westminster, as having taken place on December 21st.

Mr. Harold Percy Dow joined the Royal Engineers in 1915 as Sub-Lieutenant, and rapidly rose to the rank of Colonel, serving in Paris. His command of the French language on the technical side, and knowledge of the French and Belgian engineering industry, were of great service to the War Office during the war and immediately after the declaration of peace. At the time of the Armistice he was decorated by the French Government with the Order of Chevalier de la Légion d'Honneur.

AN important discovery of gold and silver ore is said to have been made about 100 miles to the north of Stewart, British Columbia.

SIXTY YEARS AGO.

THE year 1868, when we came to review it in our issue of January 1st, 1869, was set down as a dull one in all departments of engineering and the allied industries. It was not remarkable, so we wrote, for the accomplishment of great deeds, for the making of great discoveries or for bringing to light any great inventions. It had not taught any wonderful lessons, it had not added very largely to our experience, and it had not set at rest many disputed points. From the point of view of commercial prosperity the year had begun badly, but towards its close there were signs we found of improving trade. Engineers up in the North were fairly well employed, some agricultural engineering firms held more orders than they could execute, and in almost every direction the iron trade was looking up. These signs we held encouraged us to bid farewell for a time to despondency and to anticipate a general revival of prosperity in 1869. Passing on to review the work done during the year that had just closed we noted among the bridges that had been completed that across a branch of the Rhine at Kuilenburg, in Holland. One of the clear spans of that bridge measured 492ft., and was probably the widest span that had ever been crossed by means of girders. Other bridges that had been completed included a suspension bridge across the Niagara River, a short distance below the falls, and the Franz Joseph Bridge at Prague. The second named bridge had been designed and constructed on a principle invented by an Englishman, Mr. R. M. Ordish. Of railway work in this country almost the only thing we had to record was the completion of the great roof for St. Pancras Station. Concerning railway undertakings likely to be carried out in the near future we mentioned a proposed new line to Brighton and a railway across Canada, which, if carried out, would absorb a capital of about £20,000,000. The line to Brighton was not proceeded with, but the other scheme developed into the Canadian Pacific. The Mont Cenis Tunnel and the Suez Canal were progressing slowly but steadily towards completion, but that was all we could report concerning either undertaking. The voyage between England and France still occupied two hours and various schemes were on foot for improving the passage. One scheme stated to have been favoured by the Emperor of the French and by high engineering authorities in both countries was the construction of a railway bridge on a principle invented by Monsieur Boutet. Some in this country favoured a tunnel from Dungeness to Cape Grinez, while others favoured a service of train ferries. In mechanical engineering there was nothing new to record. High-piston speeds, theoretically right, had proved to be practically wrong. The only solution to the problem of improving the economy of the steam engine lay in the production of an efficient and practical rotary engine. Perhaps, we wrote, someone would supply such an engine during the next twelve months. In metallurgy Siemens' furnaces were found to be uneconomical, and were not gaining favour. It was admitted, however, that they produced a clean and very intense heat, and we recorded that Mr. Siemens was doing good work with them in connection with the direct reduction of ores. Dealing with the applications of electricity, we mentioned Mr. Haworth's "Method of conveying telegraphic messages without the aid of any artificial conductor." In 1863 Mr. C. F. Varley had investigated Mr. Haworth's proposals but had obtained "most negative results." Subsequently, it was reported, some doubtful experiments had been carried out across Lake Michigan. We expressed complete lack of faith in the scheme. Unfortunately we did not give any technical particulars of it, so that we are left to guess how far Mr. Haworth was working on the lines of modern wireless telegraphy.

BOOKS RECEIVED.

Calculating Chart "Crux Hydraulica." Leeds: Hathorn, Davey and Co., Ltd., Dewsbury-road. Price 5s. net.

Calvert's Mechanics' Almanack, 1929. Edited by J. Brooks. London: John Heywood, Ltd., 20, Bride-street, E.C. 4. Price 6d. net.

The Railway Policy of South Africa. By S. Herbert Frankel, M.A. Johannesburg, South Africa: Hortors, Ltd. Price not stated.

Proceedings of the Chemical Engineering Group. Volume IX. London: The Chemical Engineering Group, Abbey House, Victoria-street, S.W. 1. Price 10s. 6d. net.

Annales des Ponts et Chaussées:—(a) Partie Technique; and *(b) Partie Administrative*, 1928. Fasc. V. Septembre-Octobre. Paris: A. Dumas, 6, rue de la Chaussée d'Antin.

Notes on Half Round Sleepers of Sal and Teak. By W. A. Bailey, F. E. Cole and L. N. Seaman. Calcutta: Government of India, Central Publication Branch. Price 1s. 3d.

Sydney Harbour Trust Commissioners, Twenty-eighth Report, being for the Year ended June 30th, 1928. Sydney: Alfred James Kent, Government Printer, 1928. Price 1s. 9d.

Bridge and Structural Engineer's Handbook. Second edition. By Adam Hunter, M. Inst. C.E. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W. 1. Price 21s. net.

Forschungsarbeiten, Heft 312: Untersuchung der von Spritzvergasern gelieferten Zerstäubung. By Dr.-Ing. J. Sauter. Berlin: V. D. I. Verlag, G.m.b.H., Porotheenstrasse 40.

The Colliery Manager's Pocket-book, 1929. Edited by J. Vincent Elsden, D.Sc., and H. Greenwell, F.S.S. London: The Colliery Guardian Company, Ltd., 30, Furnival-street, E.C. 4.

The "Practical Engineer" Electrical Pocket Book and Diary, 1929. Edited by Conrad Arnold. London: The Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 2s. 6d. net.

The "Practical Engineer" Mechanical Pocket Book and Diary, 1929. Edited by E. G. Beck. London: The Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 2s. 6d. net.

Railway and Road Matters.

THE death of Mr. Justice Salter has necessitated the appointment of an *ex officio* Commissioner for England on the Railway and Canal Commission. The Lord Chancellor has now nominated Mr. Justice McKinnon to fill the vacant position.

The signal maintainer who was supposed to have been responsible for the derailment at Times Square Station, New York, on August 24th, mentioned in this column on August 31st, has been released from custody and the signalman arrested. The latter is believed to have irregularly released an electric lock.

WHEN the Great Western, as related in this column on November 9th, announced that its system of automatic train control was to be further extended, the points to be covered were not mentioned. We now learn that the installation at present in use between London and Reading is to be extended to Swindon and to Oxford, and from Old Oak Common to High Wycombe. One hundred additional engines are to have the locomotive equipment.

THE retirement on December 31st of Sir Francis Dunnell, Bart., from the position of chief legal adviser to the London and North-Eastern Railway has led to the appointment, as his successor, of Mr. I. Buchanan Pritchard, the solicitor to the Metropolitan Railway, who, in turn, has been succeeded by Mr. J. S. Anderson. Mr. H. S. Stewart, the secretary to the latter company, also retired on the same date and Mr. H. S. Chapman is the new secretary.

RAPID progress is being made with the completion of the Hudson Bay Railway to Fort Churchill. Rails have now been laid to mile 456, or 100 miles north of the point from which the work on the branching off of the road towards Churchill began last spring. Only 54 miles of rails remain to be laid to complete the road. Track laying continues at the rate of about one mile per day, and will be pushed forward as rapidly as weather conditions will allow. About 1200 men are now at work on the line.

SPEAKING recently at the prize distribution at Stratford Works, Mr. Whitelaw, the chairman of the London and North-Eastern Railway, remarked that it had been said that the amalgamation of the railways would put an end to those works. The directors had to judge such a question on its merits, and he could assure those present that there was no prospect of the works being closed. It has since, we would add, been announced that the eastern side shops are to be modernised. The works at Stratford are responsible for 5000 carriages and other passenger vehicles, or over a quarter of the whole of the L. and N.E. passenger stock.

THE Canadian Pacific Railway reports a substantial increase in its earnings during the present year. Gross earnings for the month of October amounted to 27,020,332 dollars, as compared with 21,201,713 dollars for October, 1927, an increase of 5,818,618 dollars. After deduction of working expenses at 17,014,052 dollars, the net profits were 10,006,279 dollars, as compared with 6,971,865 dollars, an increase of 3,034,913 dollars. For the ten months ended October the gross earnings were 183,588,531 dollars, as compared with 160,384,749 dollars for the corresponding period of 1927, an increase of 23,203,781 dollars, and the net profits were 41,231,568 dollars, an increase of 9,764,957 dollars over the 31,466,611 dollars for the corresponding months of last year.

IT is not often that railway witnesses make mistakes in their evidence, but Mr. H. L. Thornhill, the chief legal adviser to the London, Midland and Scottish Railway, confused two railway companies when giving testimony before the Royal Commission on Transport on December 20th. The chairman had remarked that it had frequently been suggested that railway companies gave undue preference to foreign produce. Mr. Thornhill replied that that had been suggested, but no such case had been substantiated. The old L.B. and S.C. Railway was on one occasion brought before the Railway and Canal Commissioners on that point. Its defence was that the traffic was imported from abroad in much greater quantities and under much better conditions as regards packing, so that the cost of handling was much less. The Commissioners decided that the complaint failed. With all due respect to Mr. Thornhill, we would say that the action in question was against the London and South-Western in 1895. The historical action against the Brighton Company was the Hall case in 1885, which determined the right of railway companies to make terminal charges, a right which was adjusted by the Railway and Canal Traffic Act, 1889.

THE circumstances under which a motor lorry was struck by an up express passenger train at an occupation level crossing near Shepreth on August 17th last were inquired into, on behalf of the Ministry of Transport, by Colonel Trench, whose report thereon has just been issued. No adverse criticism is passed on the gates or other features connected with the crossing as far as the railway company was concerned. Road vehicles leaving the adjacent cement works have to make a sharp turn before entering on to the crossing, but it is shown that there is a clear view of approaching up trains for a distance of 1574 yards. It is further shown that the driver of the express had not more than about 125 yards' view of the lorry. The collision completely wrecked the lorry and killed its driver. The engine of the express and the first five of the six vehicles were derailed; the engine was turned round so that its direction was reversed and the fireman was killed. Colonel Trench repeats and emphasises the recommendation of the coroner's jury that the cement company should introduce some system whereby its own customers could be piloted over the crossing. The most important part of the report is that in which attention is drawn to the fact that heavy road transport over level crossings is adding to the risks of railway travel, and in the event of the continuance and increase of similar accidents owing to neglect of reasonable precautions on the part of drivers of road vehicles, it will be for consideration whether additional safeguards in the interests of railway passengers should be provided and, if so, by whom. The report concludes by drawing attention to the advantages in the event of accident of twin articulated coaches.

Notes and Memoranda.

A TRANSMISSION line 70 miles long, for 33,000 volts, was recently constructed in forty days in Wyoming.

THE recently completed 15,000-kVA transformer station near Smith's Falls, Canada, occupies an area of 4 acres. The incoming current is received at 110,000 volts and is transformed down by a bank of three transformers with a spare unit.

IN an article in the *Bulletin* of the Hydro-Electric Power Commission of Ontario, in connection with the electrolysis of water mains and so forth, in districts supplied by electric power, Mr. W. B. Buchanan says that on one occasion he measured 23 ampères flowing in the lead sheath of a 13,000-volt cable. This sheath was carrying current from one railway track to the negative bus of a neighbouring railway system and the sheath was well loaded at the latter end.

FROM official figures which have been provided to Parliament in response to requests for information, it appears that the number of insured workers in the brick-making trade in July of 1928 was 80,090. The number unemployed on October 22nd was 9997, and on November 26th it was 10,922. The statistics of bricks imported into Great Britain and Northern Ireland during the last three years are:—1926, 228,892,000; 1927, 278,444,000; 1928, January to November, 238,679,000.

IN the automatic seamless tube mills of the Aliquippa plant of the Jones and Laughlin Steel Corporation, at Pittsburgh, two piercers are, says the *Iron and Coal Trades Review*, used in making the larger size tubes to avoid punishing the steel. This is claimed to be a new departure. Many American mills only use one piercer, even for making large tubes; but in the Corporation engineer's opinion a more nearly perfect tube is produced by using a small blank, piercing a small hole in it, and then expanding the blank with a second piercer or expander.

IN order to ascertain whether flame cutting is detrimental to the strength of structural steel, the American Bridge Company sent some typical weld connections from a 44-storey building to the United States Bureau of Standards for testing. When pulled in tension these specimens, cut from 24in. rolled joists, broke through rivet holes, and when bent under impact the only cracks appearing were short ones, originating in burrs around punched holes. A report in the American *Engineering News-Record* concludes that there is no evidence from any of the tests that fabrication by flame cutting injured the material or had any influence on the strength or reliability of the connections.

AN unusual system of insulating the heating element of an electric heater has been evolved by the Westinghouse Electric Company of America. The actual heating element, which is resistance wire of a high melting point, is wrapped round with metallic magnesium ribbon and the whole is then inserted in a copper tube. Steam at 450 lb. pressure is forced through the tube and the magnesium then changes into its oxide. The result is a tube containing a heater wire which is embedded in a hard, dense, white substance resembling marble. The ends of the tube are then sealed up with electrical contacts projecting. The tube itself can be formed to any of a multitude of shapes, and can be soldered, brazed, or otherwise assembled in any desired mounting. The heating unit thus formed is almost indestructible in normal use.

A REPORT from Stockholm states that the Consumers' Co-operative Association is starting the trial production of building and insulating material made from straw. If the trial is successful, the process will be of some importance to agriculture, as it will make use of a by-product hitherto exploited to only a small extent. In Sweden at present 20,000 tons of straw a year are finding no use at all. Another industry using straw as a raw material may soon be established, namely, a paper mill using the Rinman process, in which the waxy element in the straw acts as a binder, the paper produced being said to be very strong, and air, water and grease proof. It is proposed to build a mill with an annual capacity of 6000 tons of fine paper at Ystad in the extreme south of Sweden, at an estimated cost of Kr. 4,500,000, but no definite decision has yet been arrived at.

EXPERIMENTS on irrigated test plots were carried on near Prosser, Wash., during the past few years by the United States Department of Agriculture to obtain data on soil moisture as affecting the proper depth of irrigation. The soil was a sandy loam with moisture equivalent to 16 per cent.; it was capable of holding 16in. of water in the upper 6ft., and when all available water had been absorbed by a crop it still contained 5in. water in the same layer. In ordinary irrigation practice water would be applied when the moisture in 6ft. has been reduced to about 10in. If only 4in. to 6in. of water is applied in each irrigation, it is therefore unlikely that any effective leaching can occur. The authors (C. S. Scofield and C. C. Wright, in *Journal of Agricultural Research*, July 15th, 1928) conclude that in order that leaching of the root zone may occur to prevent accumulation of the salt contained in the irrigation water, it is necessary to apply more water than is customarily used.

THE United States Steel Corporation has erected a large and well-equipped tar distillation plant at Clairton, Pennsylvania, near Pittsburgh, where the Corporation operates the largest unit of coke ovens in the world. The plant consists of over 1500 ovens and is carbonising daily about 30,000 tons of coal. The ovens operate on one class of uniform high-grade coking coal, and the tar obtained is of an unusually high quality, and yields a superior creosote from a wood preserver's point of view. Over a year was spent in the preparation of the plans before construction began. The design, erection and first operation of the Clairton tar plant was carried out by Robinson, Butler, Hemingway and Co., of New York, the engineers who, some two years ago, brought into operation as half owners the plant of the Inland Tar Company, in conjunction with the Inland Steel Company of Chicago. The Clairton plant, which has now been in full operation for three months, represents, in one unit, an output equal to almost one-half of America's natural creosote-consuming increase shown between 1926 and 1927.

Miscellanea.

IT it proposed to build a large modern port at Torres, in the state of Rio Grande-do-Sul, Brazil, and negotiations regarding plans and cost are proceeding between the Federal and State Governments.

CERTAIN residents at Burnley have claimed compensation for alterations of their radio receiving apparatus which have been necessitated by the alteration of the municipal electricity supply system serving their houses. Some of the claims are to be repudiated, whilst others have been referred to a Committee.

THE total production of electrical energy in Sweden during the past year increased by about 10 per cent., and amounted to 4385 million kilowatt hours, of which one-third was generated by Government power plants. The gross revenue from electric power sold during 1927 amounted to nearly 120 million kronor.

IN reply to a question regarding wireless receiving licences in Wales, the Postmaster-General, Sir William Mitchell-Thomson, stated that the total number of licences in force on October 31st in the whole of Wales was about 80,600, which was equivalent to a rate of 36·5 per 1000 of population. The corresponding rate for England was 62·8, for Scotland 37·3, and for Northern Ireland 21·9.

CONSIDERABLE progress was made during 1928 with the preliminary work of organising the various area electricity schemes into which Great Britain is to be divided, and during the present year the expenditure on contracts for equipment and construction should be substantially heavier than in 1928. The result should be more employment than hitherto in the manufacture of machinery, though the effect may not be immediately felt.

DELEGATES from forty nations attended an International Conference in Paris for the limitation of exhibitions, when a convention was signed, agreeing to limit the number of general long-period exhibitions which are officially recognised to once in ten years at the least in the same country and once in two years at least in all countries. Special exhibitions confined to one trade or industry are limited less strictly. The convention does not apply to any exhibitions which do not seek official recognition or to sample fairs such as that of Lyons or the British Industries Fair.

THE Secretary for Mines has now issued General Regulations under the Coal Mines Act, 1911, to make provision for the safe conduct of rescue and other necessary work after an explosion or fire, or otherwise in an atmosphere that may be dangerous to life, at mines in which coal or oil shale is worked. The Regulations are in the same terms as the draft issued with the Mines Department letter of September 3rd, 1928, and came into force on January 1st, 1929. They will effect important changes in the organisation of rescue work and the training of rescue workers, and should be carefully studied by owners and managers of mines and rescue station authorities in comparison with the existing regulations, which they supersede.

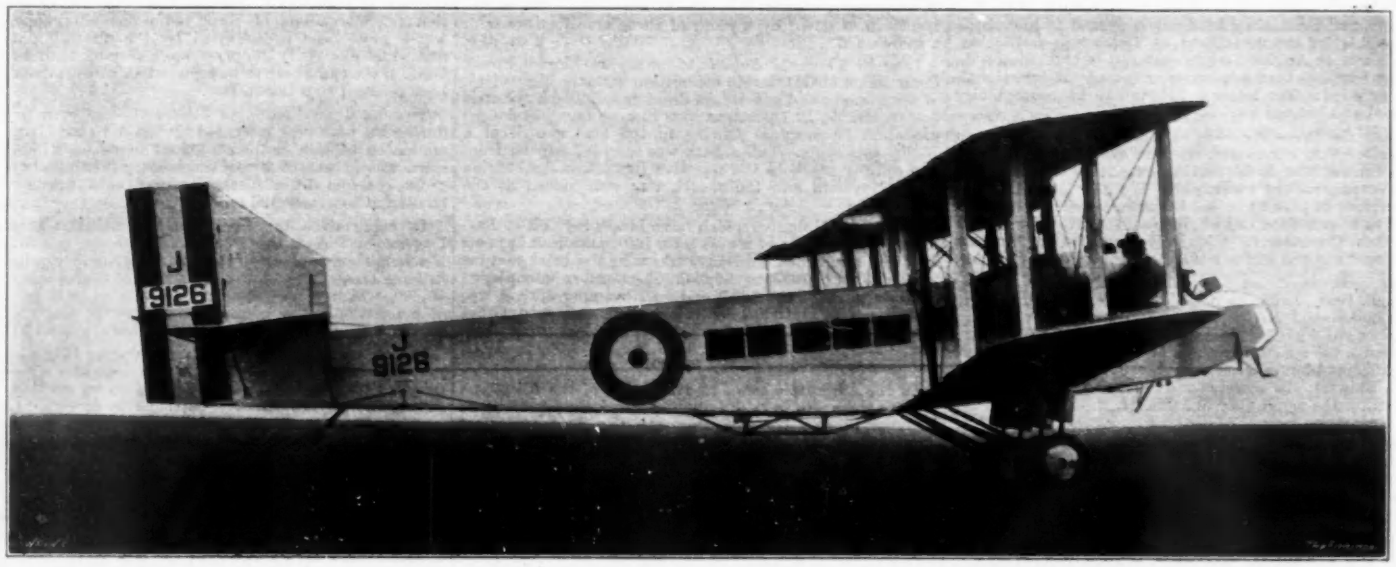
QUESTIONS as to the relative rights of water-borne traffic over land traffic continue to be of great concern at certain points throughout the United States of America. At Chicago, where closing of the drawbridges over the Chicago River has been in effect during morning and evening rush hours for a number of years, day-time delays are becoming so serious that a proposal to close the bridges during the entire business day, is, says the *Engineering News-Record*, being considered. The chief difficulty in the whole situation, it appears, lies in the fact that the American War Department, which is in chief control of the waterways of the country, is set up as the judge to decide upon whether or not drawbridges shall be closed during certain hours. Regardless of how impartial the army engineers endeavour to be, it is but natural for them to give special consideration to the pleadings of those who favour keeping the waterways open.

IT is not generally known, says the *South African Mining and Engineering Journal*, that Dr. A. L. du Toit, formerly of the Union Geological Survey and now Geological Adviser to De Beers, has lately been visiting Tanganyika Territory with a view to investigating the diamondiferous occurrences of that country. Dr. du Toit has prepared two separate reports, one dealing with the Tanganyika Diamond Mine and the other with the Shinyanga property of the Central Tanganyika Diamond Company, Ltd. Copies of both these reports have very courteously been supplied to the two companies concerned by Dr. du Toit, and it is said that his views on the geology of the occurrences very closely agree with those expressed by Mr. H. S. Harger. Development of the newly found diamond mines of Tanganyika is being steadily pursued, and when the rainy season is over a big increase in the scale of operations will, our contemporary states, doubtless take place.

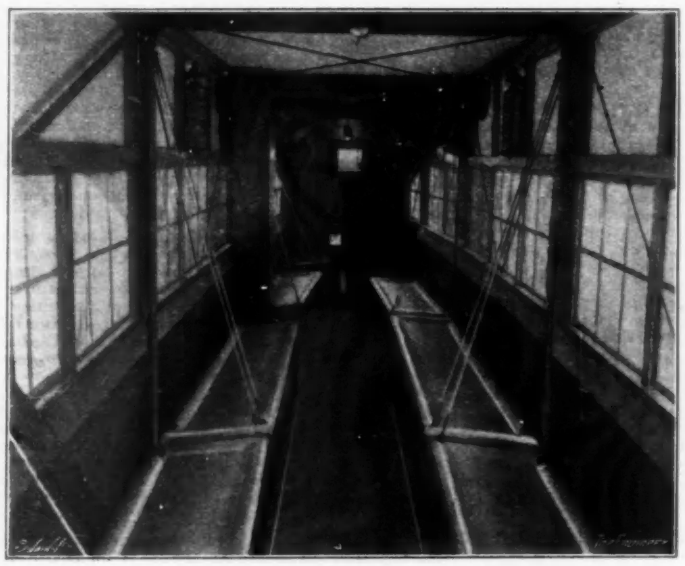
IT is reported that during the past few months considerable progress has been made by the Free State Electricity Supply Board in getting its organisation under way for taking over the Shannon power works and high-pressure distribution system, when they are completed. In the Greater Dublin area the contractors who are laying the high-power feeder cables are well advanced with the work. Contracts for the transformer kiosks and switchgear and for the erection of the transformers in this area were placed with Ferguson, Pailin, Ltd., and the Asea Electric, Ltd. The work of erecting the distribution networks and house services in the twenty-three Leinster towns which is is proposed to supply this winter, is proceeding satisfactorily, and will be finished before long. Considerable progress is also being made in Templemore, Tipperary, Cashel, Doon, Cappawhite, and Cappamore. The Irish Electrical Construction Company, which is carrying out the work in all these towns, has also received the contract for distribution networks and house services in Carrick-on-Suir, Lismore, Tramore, Cappoquin, Tallow, Dunmore East, and Passage East. The contract for the erection of transformer kiosks and switchgear in the Leinster towns was placed with the English Electric Company, Ltd., and for its immediate requirements in transformers the Board has decided to share the contract between the Asea Electric Company, Ltd., and the British Thomson-Houston Company, Ltd.

AERONAUTICS IN 1928

(For description see page 4)

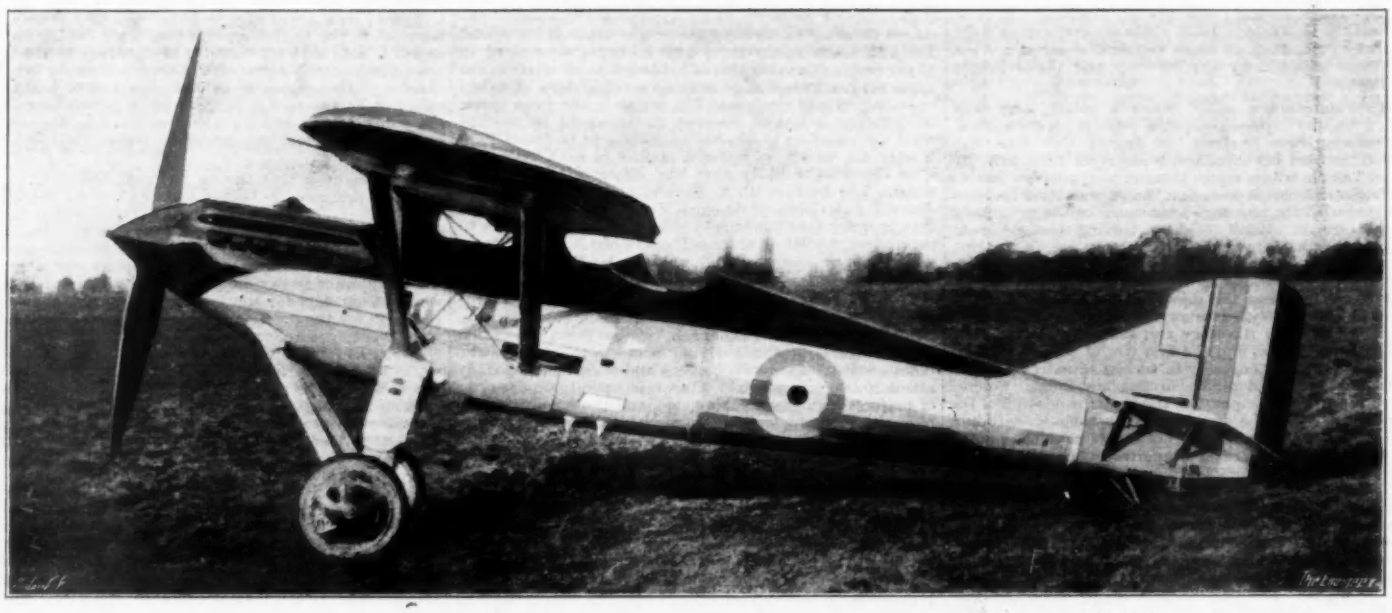


HANDLEY PAGE "CLIVE" TWIN-ENGINED TROOP CARRIER



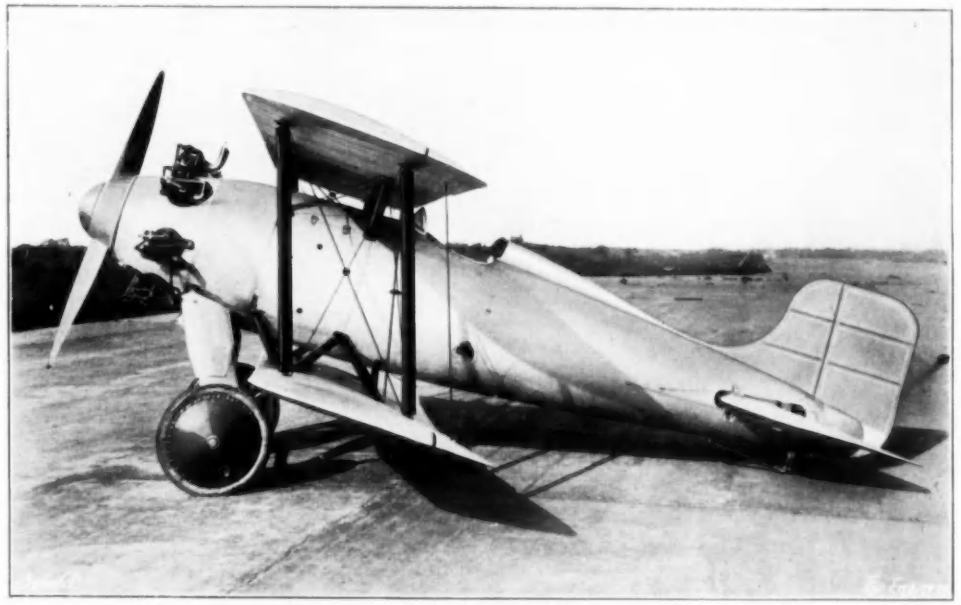
INTERIOR OF "CLIVE" TROOP CARRIER

HOLD OF VICKERS "VELLORE" FREIGHT CARRIER

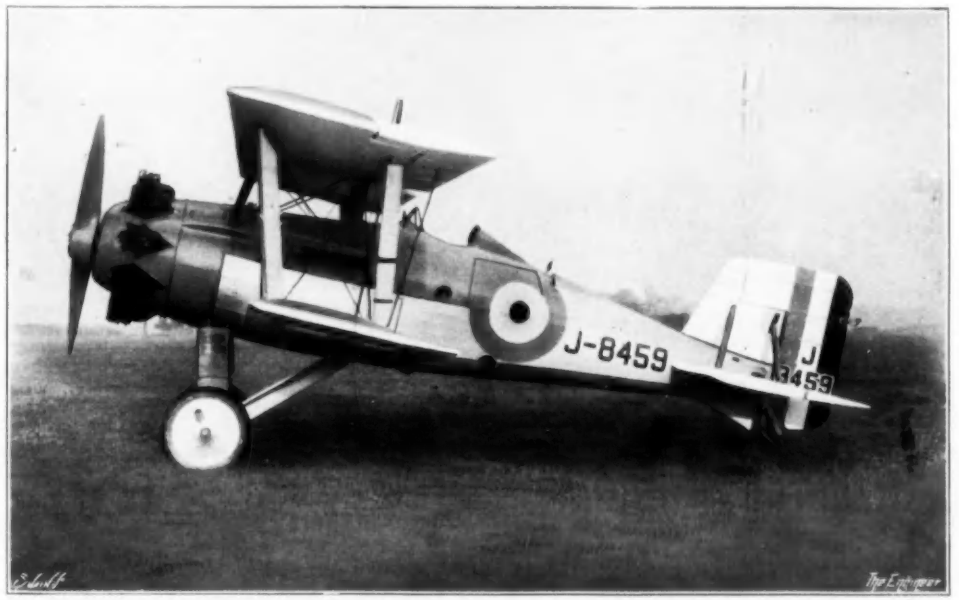


WESTLAND "WIZARD" SINGLE-SEATER MILITARY MONOPLANE

SOME AEROPLANES OF 1928



BLACKBURN "LINCOCK" SINGLE-SEATER FIGHTER

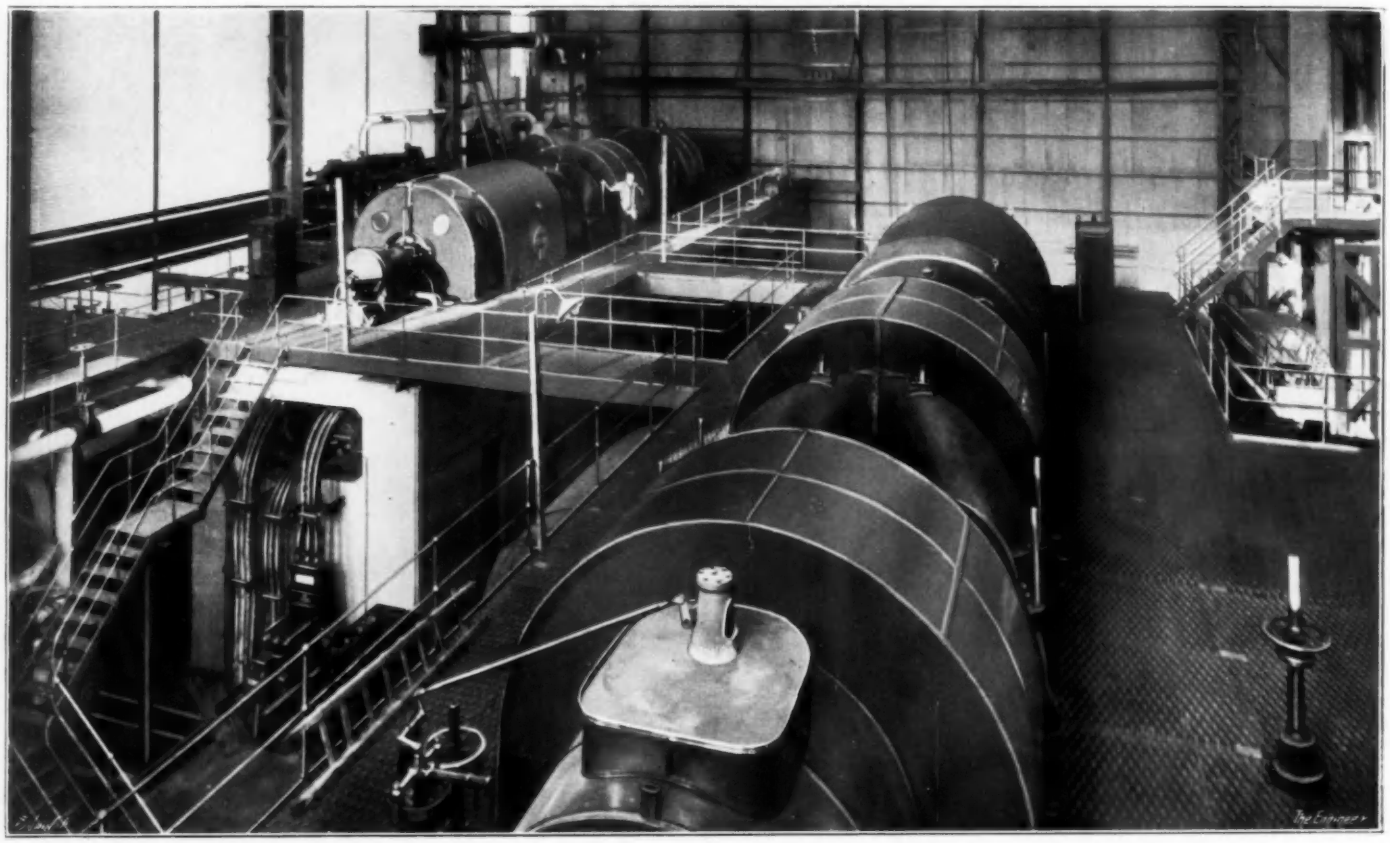


BOULTON AND PAUL "PARTRIDGE" SINGLE-SEATER FIGHTER

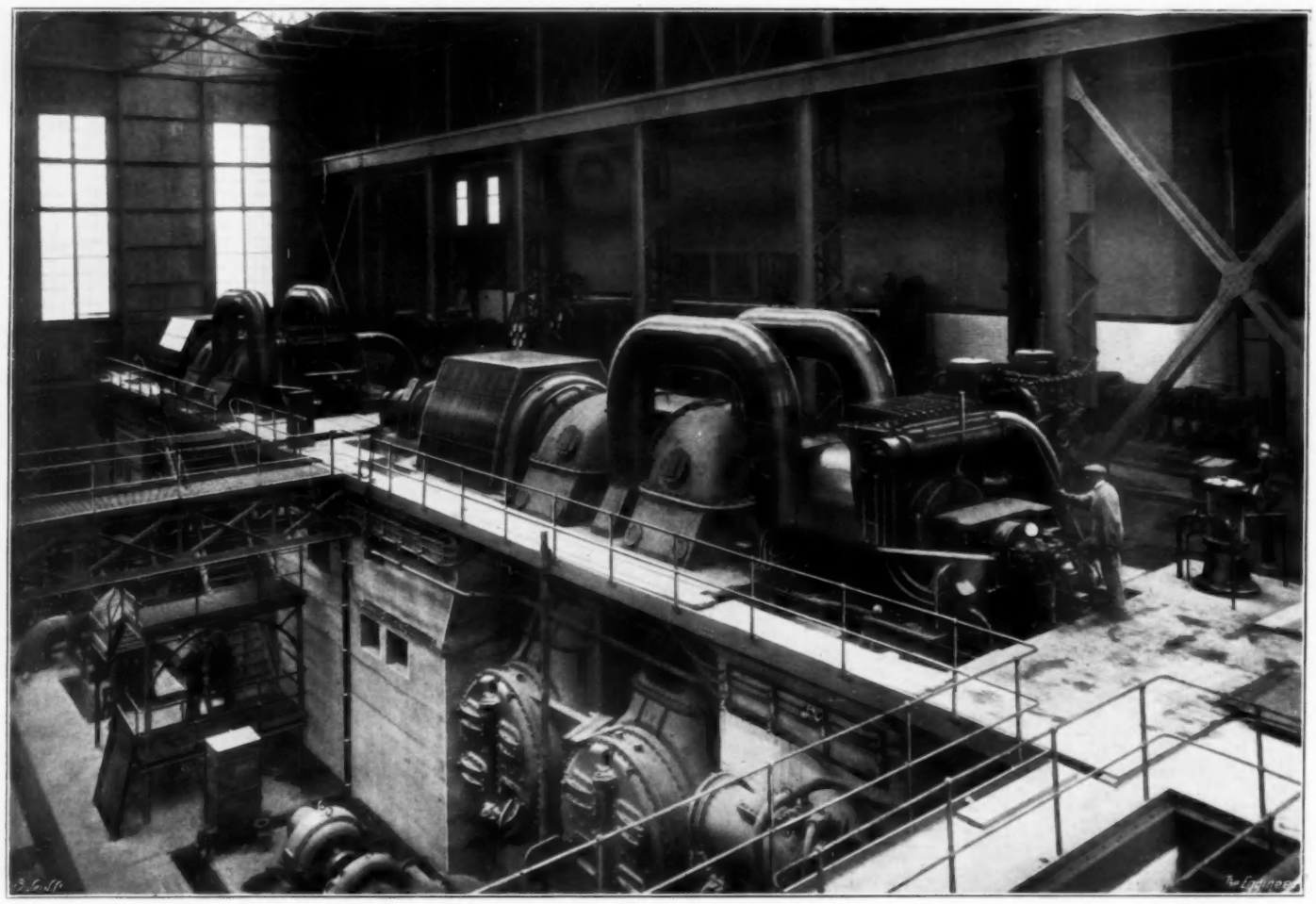
DE HAVILLAND "GIPSY MOTH" TWO-SEATER LIGHT AEROPLANE

VICKERS "VELLORE" FREIGHT CARRIER

ELECTRICAL ENGINEERING IN 1928

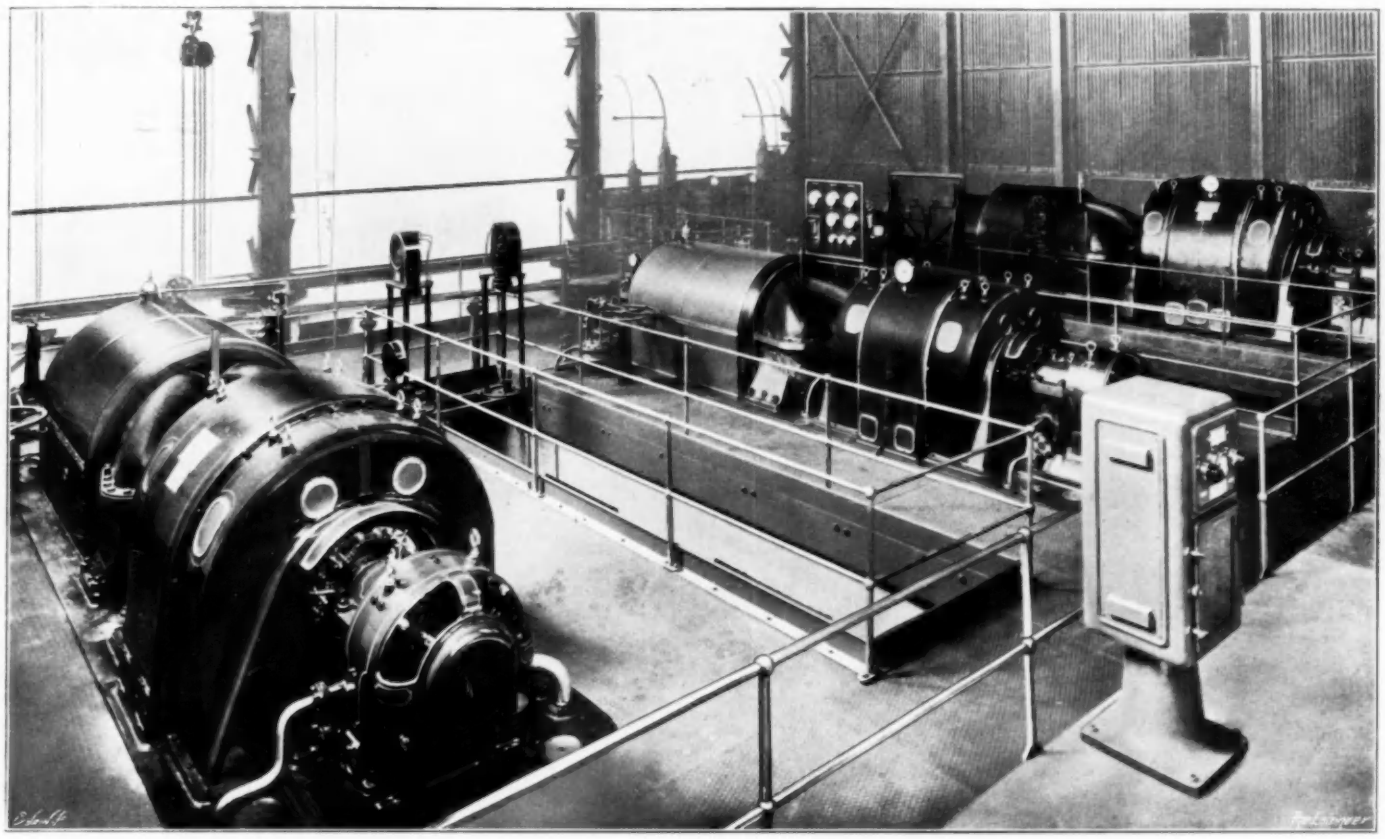


25,000 kW TURBO-GENERATORS AT BRIMSDOWN

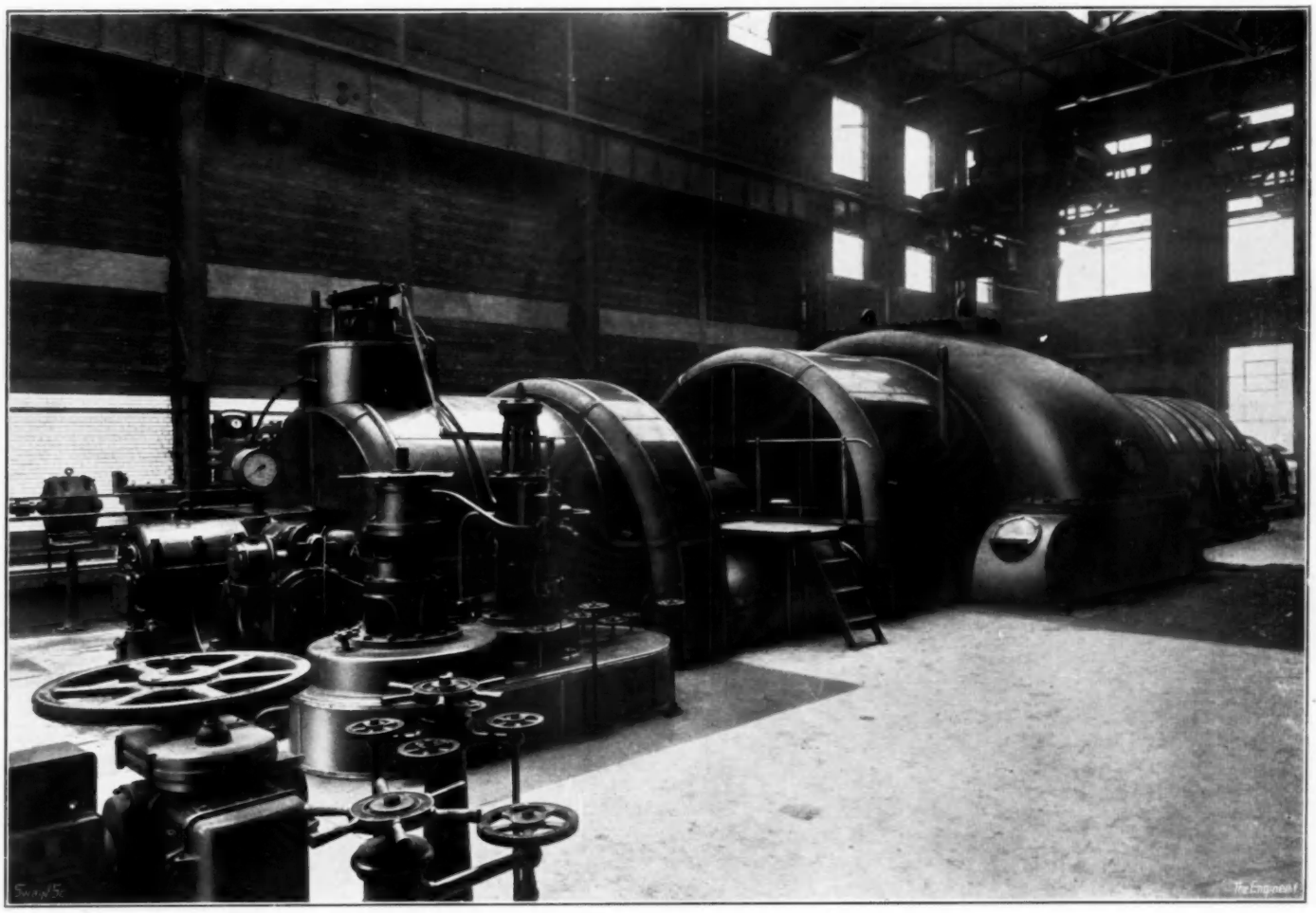


20,000 kW TURBO-GENERATORS AT COVENTRY

ELECTRICAL ENGINEERING IN 1928



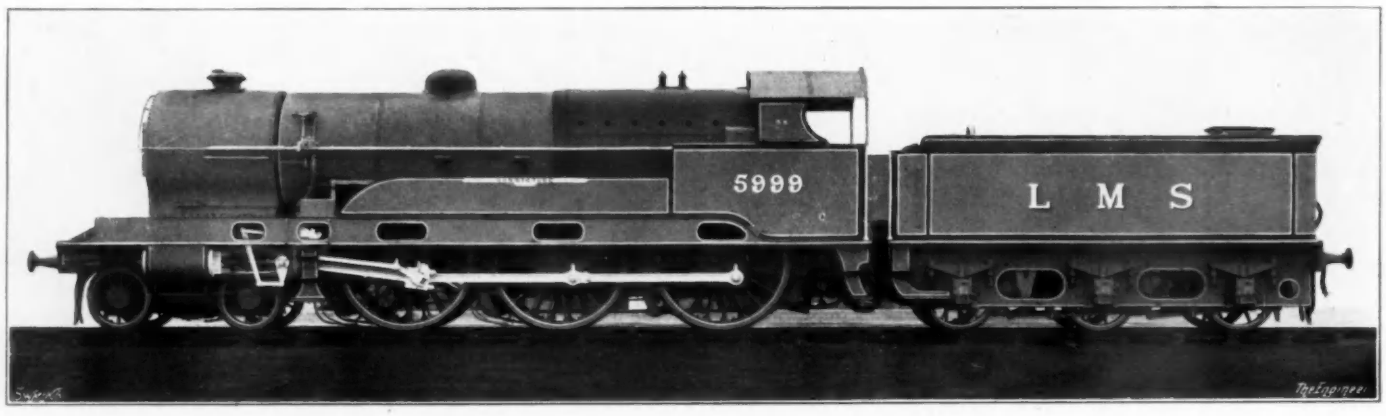
Interior of Turbo-Generator House of the Guildford Power Station



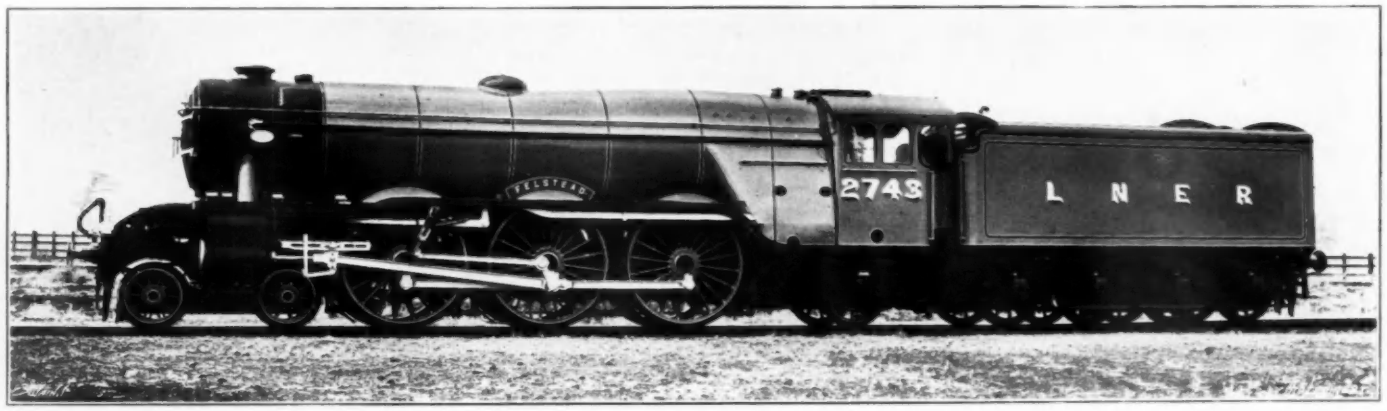
40,000 kW Turbo-Generator in Barton Station, Manchester

UNIV. OF MICH.

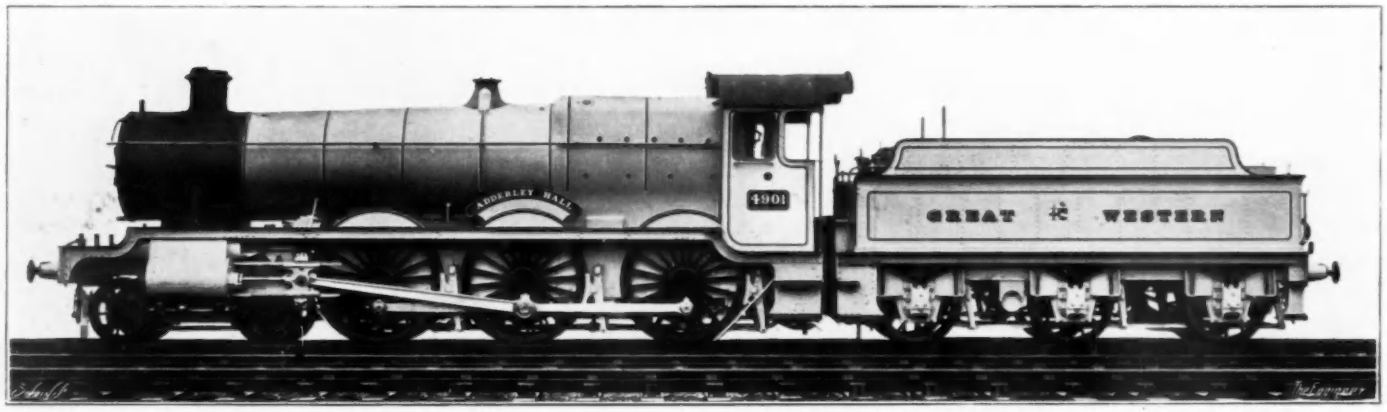
SOME LOCOMOTIVES OF 1928



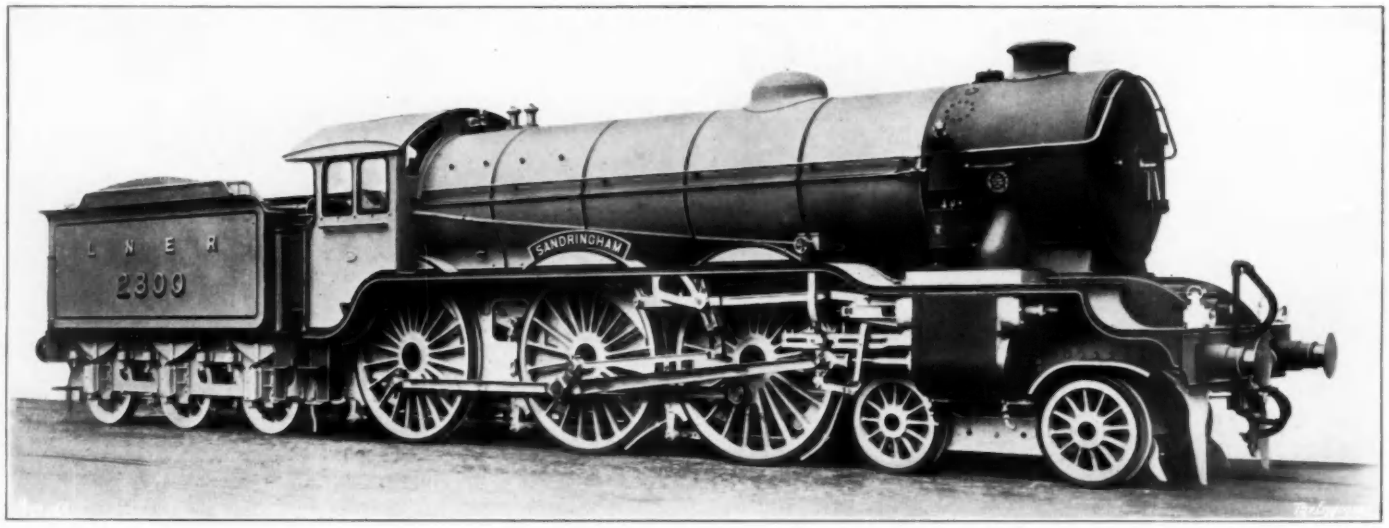
L.M.S.—MODIFIED "CLAUGHTON" PASSENGER LOCOMOTIVE



L.N.E.R.—PASSENGER ENGINE AND CORRIDOR TENDER

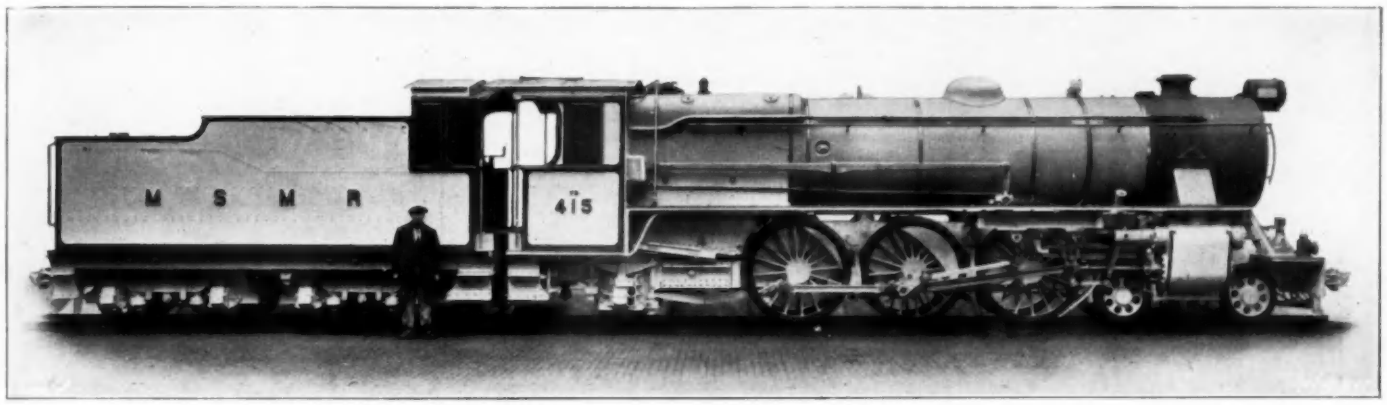


G.W.R.—TWO-CYLINDER PASSENGER LOCOMOTIVE

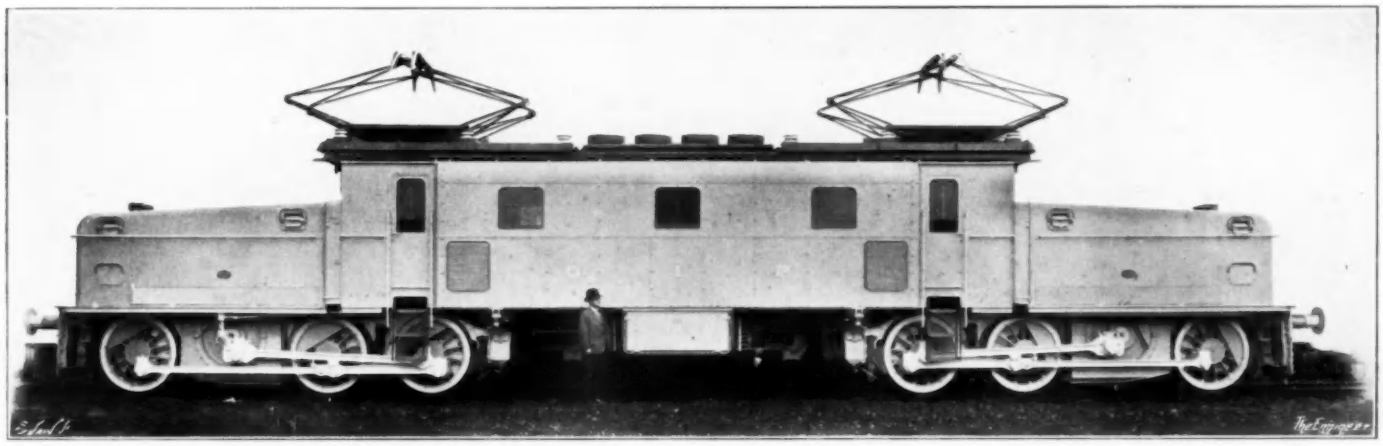


L.N.E.R.—PASSENGER ENGINE FOR THE GREAT EASTERN SECTION

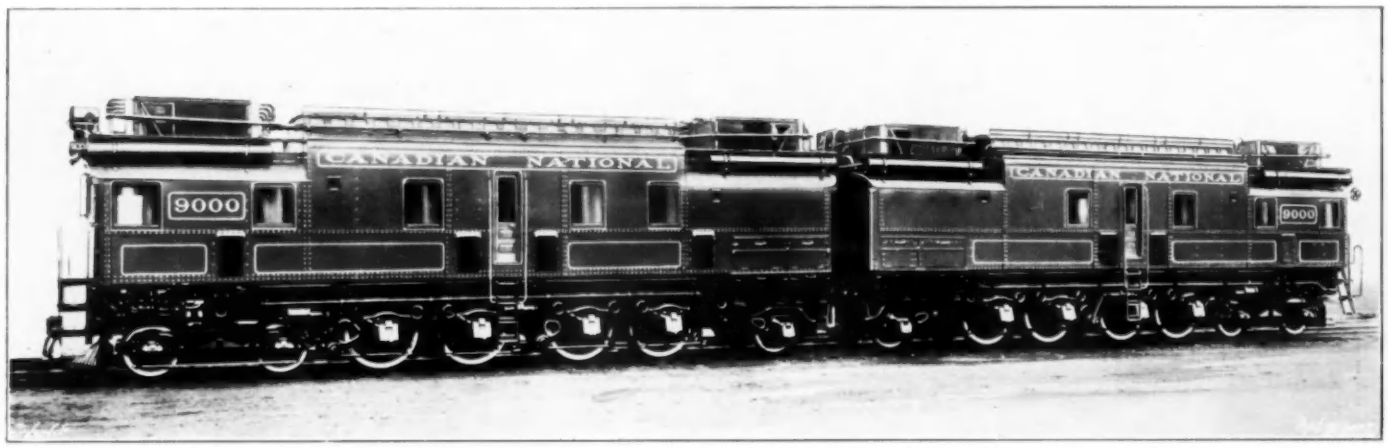
SOME LOCOMOTIVES OF 1928



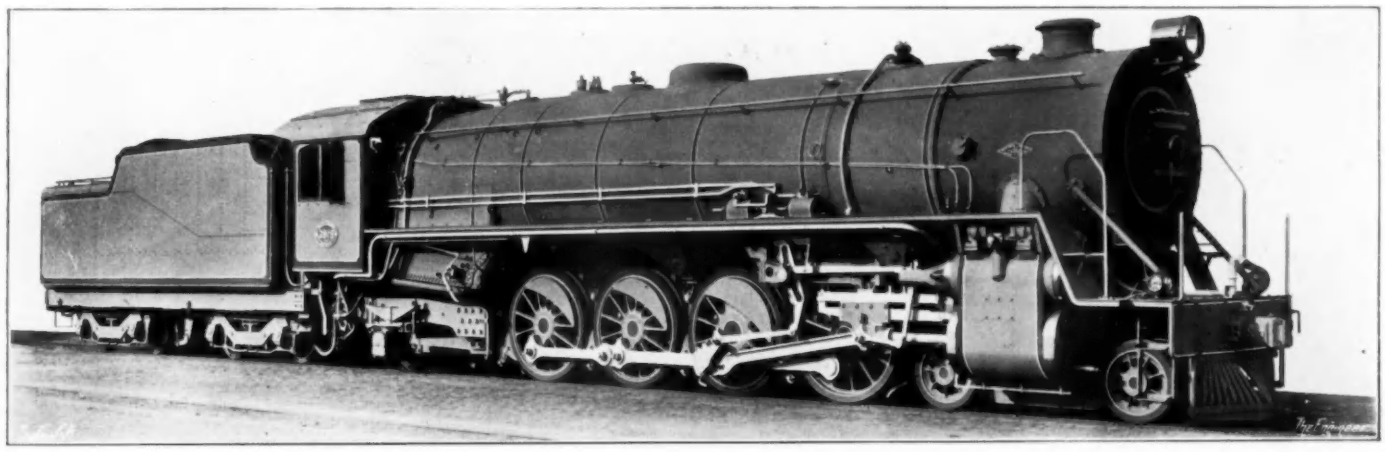
M.S.M.R. "Y.C." STANDARD METRE-GAUGE LOCOMOTIVE—NASMYTH, WILSON



G.I.P.R. ELECTRIC LOCOMOTIVE—VULCAN FOUNDRY AND METRO-VICK

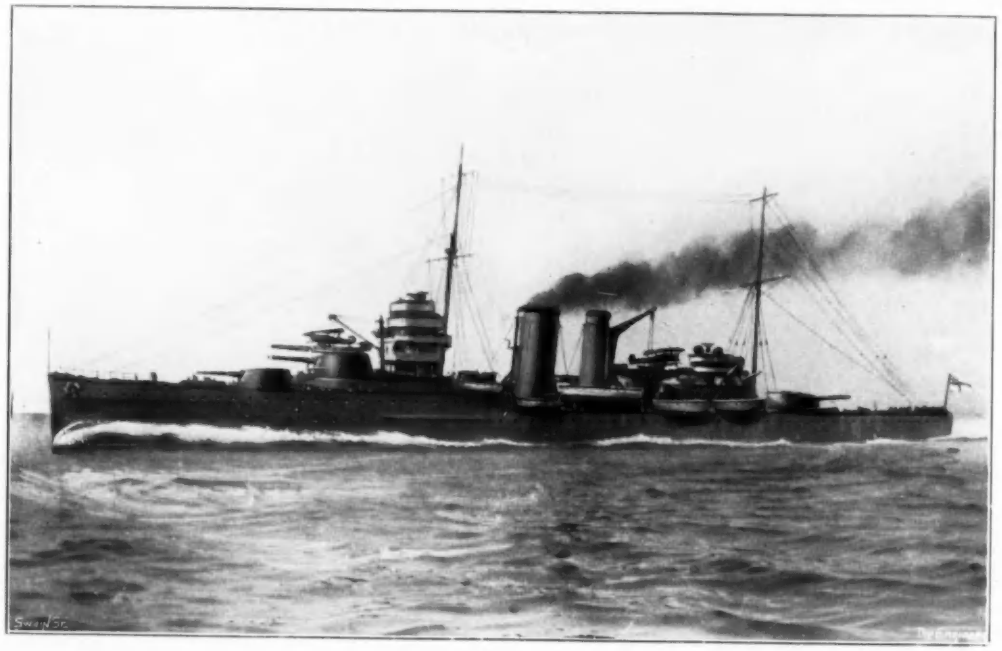


C.N.R.—OIL-ELECTRIC LOCOMOTIVE WITH BEARDMORE ENGINES



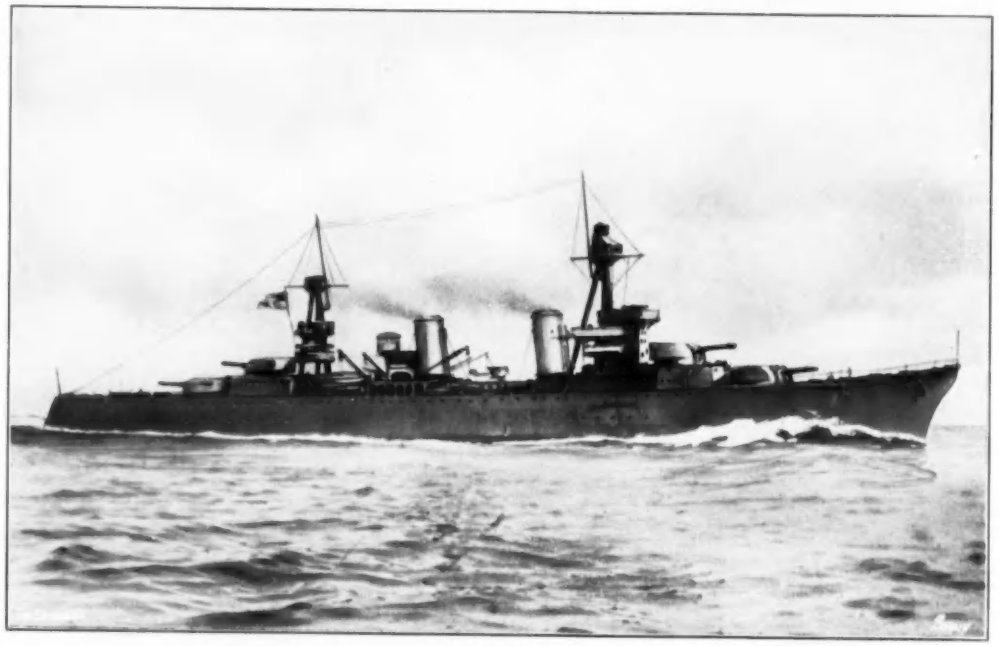
S.A.R.—MIXED TRAFFIC LOCOMOTIVE—NORTH BRITISH

SOME CRUISERS OF 1928



H.M. CRUISER YORK

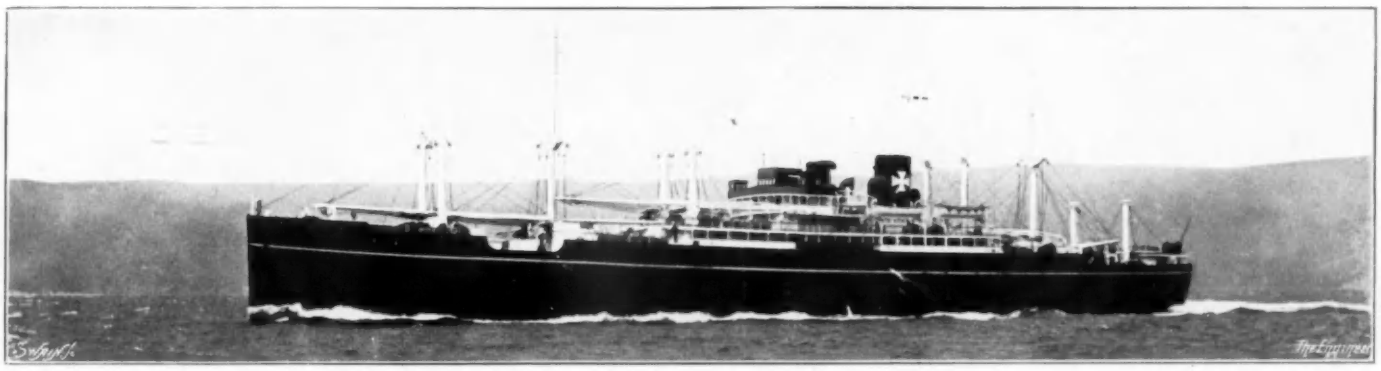
JAPANESE CRUISER AOBA



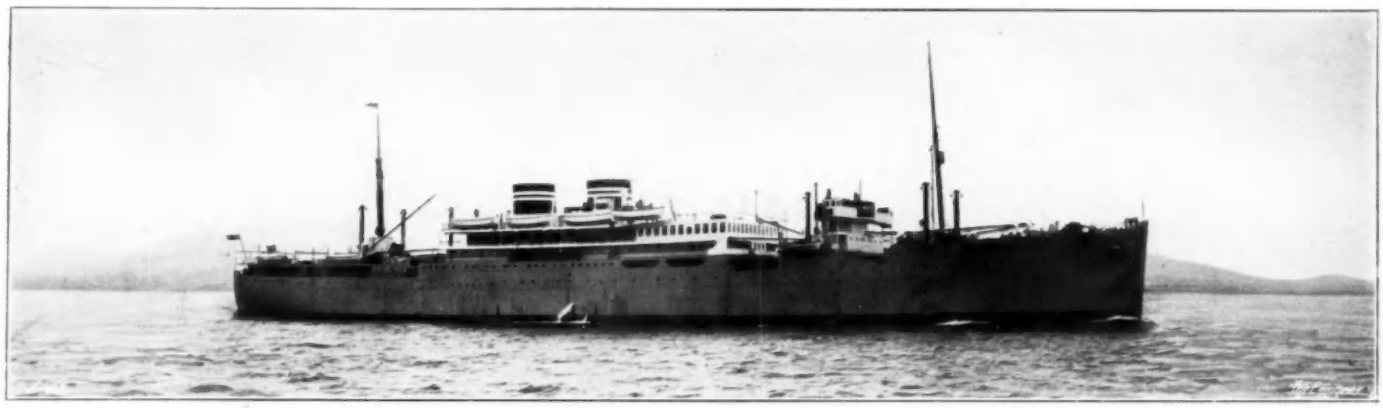
U.S. CRUISER PENSACOLA

FRENCH CRUISER TOURVILLE

SOME MOTOR SHIPS OF 1928

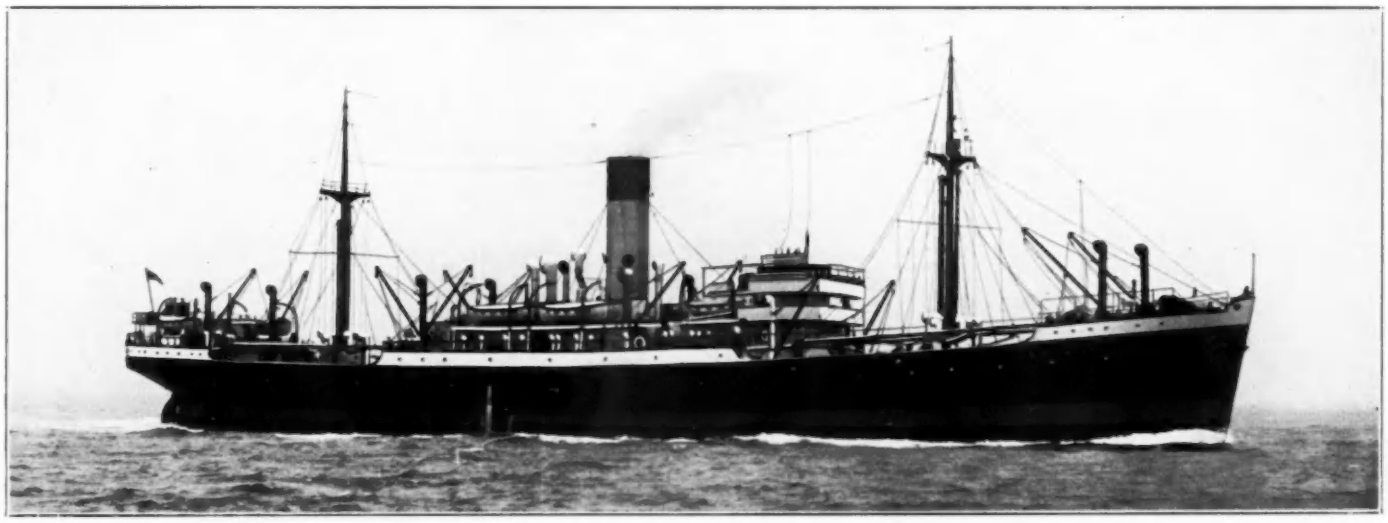


THE HOULDER LINE REFRIGERATED CARGO MOTOR SHIP DUNSTER GRANGE



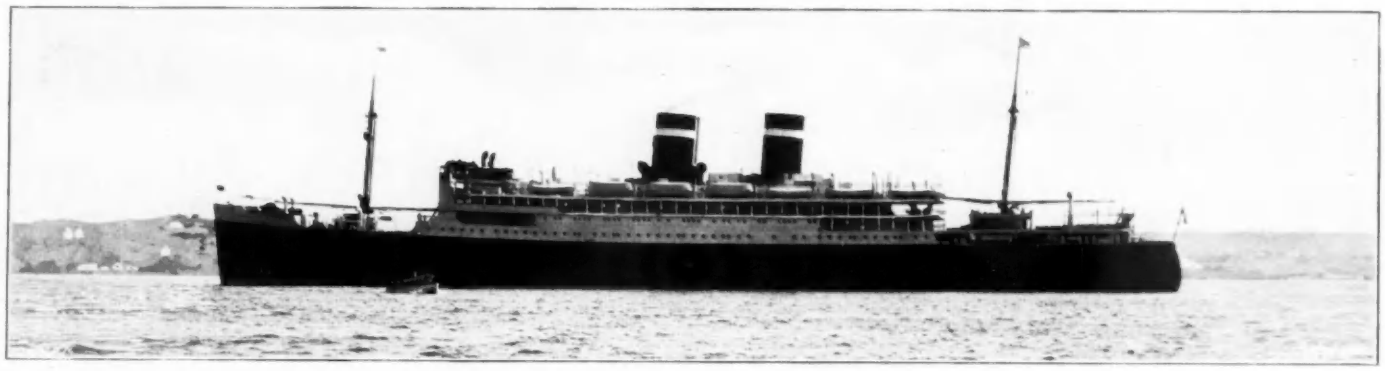
THE NELSON LINE PASSENGER AND REFRIGERATED CARGO MOTOR SHIP HIGHLAND MONARCH

THE OIL-ELECTRIC OIL TANKER BRUNSWICK

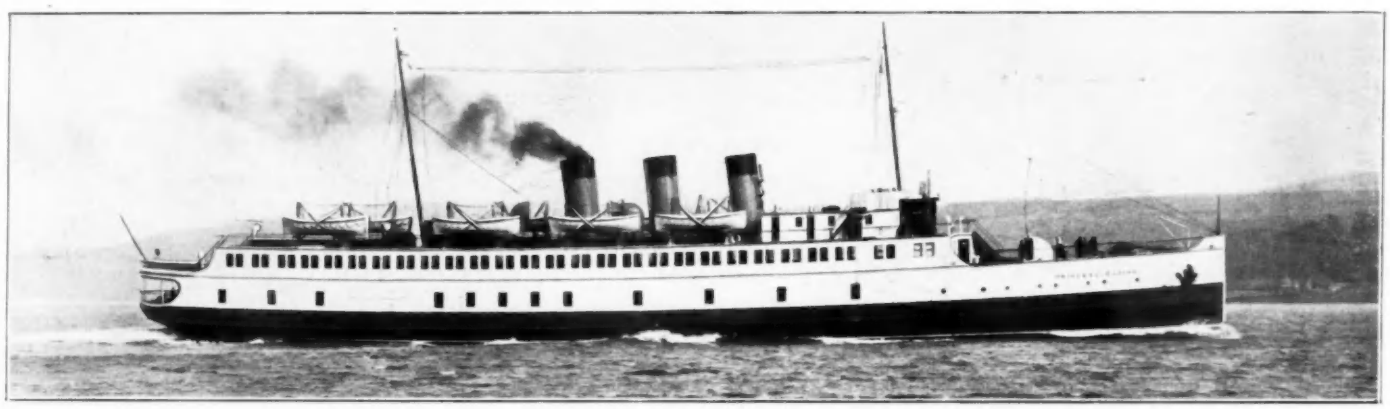


THE HOLT LINE SCOTT-STILL ENGINED CARGO MOTOR SHIP EURYBATES

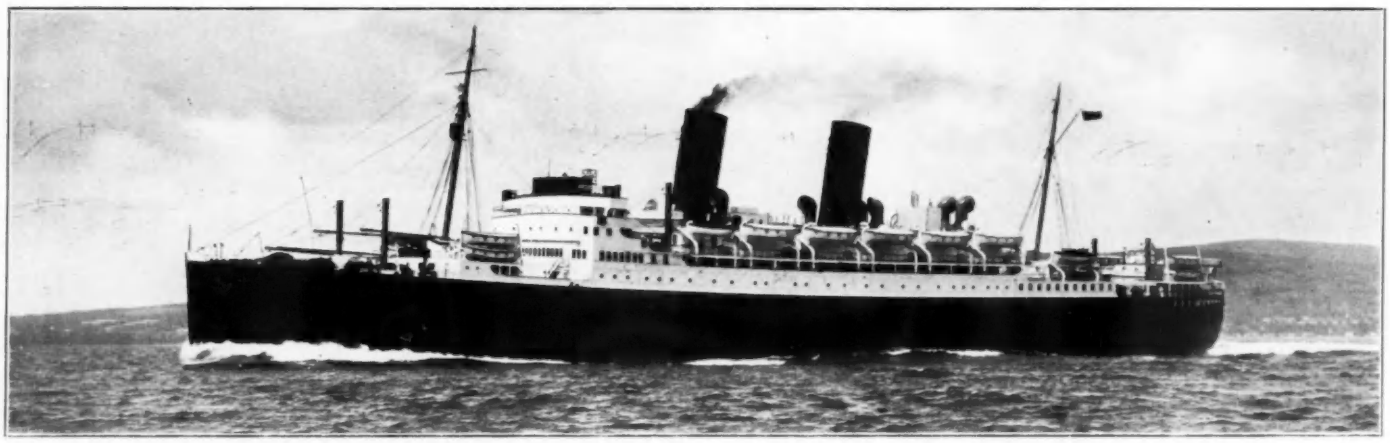
SOME STEAMSHIPS OF 1928



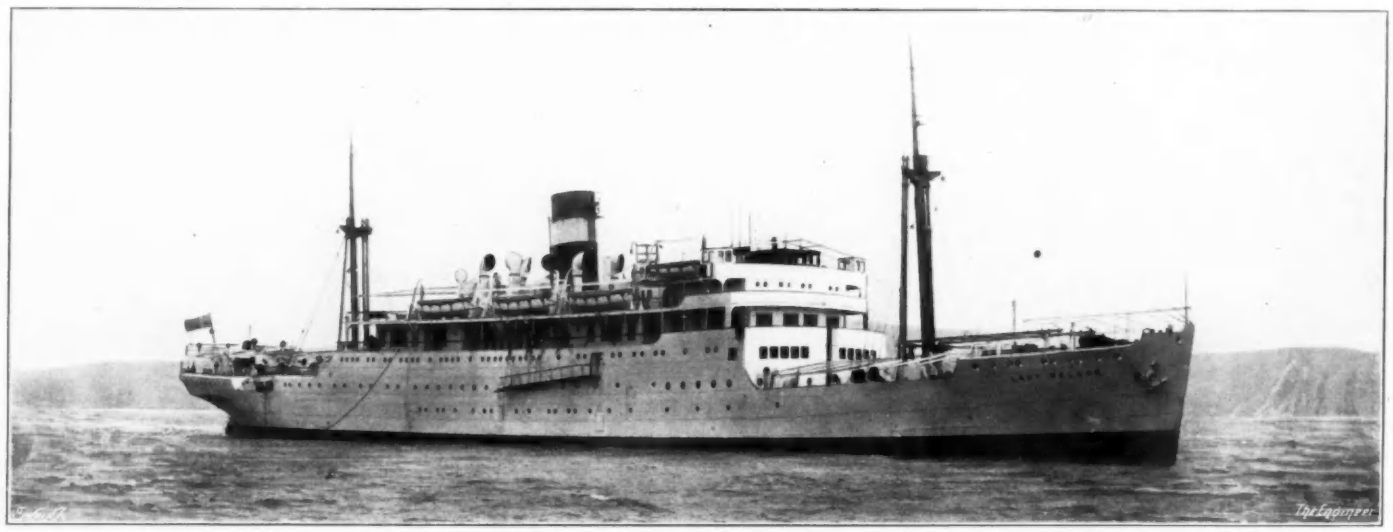
THE PANAMA-PACIFIC TURBO-ELECTRIC LINER CALIFORNIA



THE C.P.R. COASTAL STEAMSHIP PRINCESS ELAINE



THE CANADIAN PACIFIC LINER DUCHESS OF BEDFORD



THE CANADA-WEST INDIES LINER LADY NELSON

The Engineer
Annual Subscription Rates
(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES	.. ..	£3	5	0	
CANADA	.. .. ..	£3	3	0	Thick Paper edition.
		£2	18	6	Thin Paper edition.
ABROAD	.. .. ..	£3	7	6	Thick Paper edition.
(except Canada)		£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and Sons, Ltd.,
† £3 3s. 0d.	29–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINA ..	BUENOS AIRES : Mitchell's Book Store, 576,
* £3 7s. 6d.	Cangallo
† £3 3s. 0d.	
AUSTRALIA ..	Gordon and Gotch (Australasia), Ltd. All
* £3 7s. 6d.	Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens,
	Elizabeth-street
BELGIUM ..	BRUXELLES : W. H. Smith and Son, 78–80,
* Fr. 590	Rue du Marché-aux-Herbes
† Fr. 550	
CANADA	American News Company, Ltd. All Branches
* $15·25	MONTREAL : Gordon and Gotch, Ltd., 334,
† $14·25	Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87,
	Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 81,
	Queen-street West.
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh, Ltd.
* $37	SHANGHAI : Kelly and Walsh, Ltd.
† $34·5	
EGYPT	CAIRO : Express Book and Stationery Store,
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi
† £3 3s. 0d. (Pt. 308)	
FINLAND ..	HELSINGFORS : Akademiska Bokhandeln,
* M. 650	Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue de la
* Fr. 418	Banque, 22
† Fr. 390	PARIS : Berger Leverault, 229, Bld. St.
	Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
GERMANY ..	BERLIN : H. Hermanns, Friedrichstrasse 218,
* R. mks. 70·00	S.W. 48
† R. mks. 65·00	WESTERN GERMANY : Fritz Rehfus, Blumen-
	thalstrasse 10, Cologne
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND ..	ROTTERDAM : Hector's Boekhandel, Noord-
* Fl. 41·00	blaak 59
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"
	Gelderschestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA : Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307, Corso
† Lire 280	ROME : Fratelli Treves, Corso Umberto 1, 174
	ROME : Fratelli Bocca
JAPAN	Maruzen Co., all Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply Co.
* £3 7s. 6d.	
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and Tombs, Ltd.
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches
† £3 3s. 0d.	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Mezhdunarodnaya Kniga, Pros-
* £3 7s. 6d.	pect Volodarsky, 53 A
† £3 3s. 0d.	MOSCOW : "Litisdat," Kousnetsky Most, 5–15
STRAITS SETTLEMENTS	SINGAPORE : Kelly and Walsh,
* $29·25	Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens Journal-
* Kr. 61·00	expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl.,
	Hofbokhandel, Fredsgatan, 2
SWITZERLAND	BERNE : Joh. William De Groot, Laupenstr. 5
* Fr. 85·20	ZURICH : Rosa Leibowicz, 4, Ankerstr.
† Fr. 79·50	
UNITED STATES	International News Co., 131, Varick-street,
OF AMERICA	New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post Office,
† $15·25	New York, N.Y., December 12th, 1896, under the
	Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch —minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. Central 2256, 2257.

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents

THE ENGINEER, January 4th, 1929.

	PAGE
A SEVEN-DAY JOURNAL	1
NAVAL CONSTRUCTION IN 1928. (Illus.)	2
AERONAUTICS IN 1928. No. I. (Illus.)	4
MOTOR VESSELS AND MARINE OIL ENGINES IN 1928. No. I. (Illus.)	6
ELECTRICAL ENGINEERING IN 1928. No. I. (Illus.)	10
OBITUARY—	
A. T. Hollingsworth	12
Colonel H. P. Dow	12
SIXTY YEARS AGO	12
BOOKS RECEIVED	12
RAILWAY AND ROAD MATTERS	13
NOTES AND MEMORANDA	13
MISCELLANEA	13
1928—A RETROSPECT	15
LOCOMOTIVES OF 1928. (Illus.)	17
WATER SUPPLY IN 1928. No. I.	21
STEAMSHIPS AND STEAM MARINE ENGINEERING IN 1928. No. I. (Illus.)	22
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	24
Lancashire	25
Sheffield	26
North of England	26
Scotland	27
Wales and Adjoining Counties	27
CALENDARS, DIARIES, &c., FOR 1929	27
PERSONAL AND BUSINESS ANNOUNCEMENTS	27
CONTRACTS	27
CURRENT PRICES FOR METALS AND FUELS	28
FRENCH ENGINEERING NOTES	29
BRITISH PATENT SPECIFICATIONS. (Illus.)	29
FORTHCOMING ENGAGEMENTS	30

TWO FOUR-PAGE SUPPLEMENTS—CRUISERS, LOCOMOTIVES, MOTOR SHIPS, STEAMSHIPS, AEROPLANES AND ELECTRICAL ENGINEERING IN 1928.

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

DEATH.

ON November 26th, 1928, at Jalpaiguri, N. Bengal, India, of heart failure following pneumonia, HAROLD VAUGHAN SMITH, A.M. Inst. C.E., Executive Engineer, Public Works Department, India, aged thirty-four years.

THE ENGINEER.

JANUARY 4, 1929.

1928—A Retrospect.

NINETEEN TWENTY-EIGHT was an uneventful year. At home there are no great events to its credit and in the whole world but a few. It was a year, as far as Great Britain is concerned, of continual struggle to arise from the slough of depression in which the feet of the engineering industry are entangled; it was a depressing year in many respects, yet towards the end of greater hopefulness in the engineering industries than its immediate predecessors. There was a steady improvement in the amount of work done, and even in the iron and steel industry there was, in the later months, in the words of the market reporter, a "better tone." Unemployment remained throughout at a high level, higher than in 1927, and in one industry, coal mining, caused grave anxiety and deep sympathy; but with that exception even it, in the last few months, showed some signs of improvement. It is now fairly generally acknowledged that the mining industry cannot hope to return to its old proportions, and steps of various kinds were taken to find occupation for the displaced miners in other industries at home and in the Dominions.

Unemployment.

Sympathy with distress prompts actions in relief of unemployment, but we cannot hide from ourselves the fact that they tend to undermine the self-reliance of the individual. Economists of other nations regard the "dole"—unemployment benefit—with astonishment, and there are not a few in this country who believe that a percentage of the unemployment may be directly attributed to it. No one questions that the dole is as unsound as State subsidies, but no one, at the minute, sees any means of getting rid of it without serious consequences. Others hold that the industrial population of Great Britain is larger than she can support in full employment in the state of life which is now demanded. There can be little or no doubt that with lower wages and a lower standard of living, and with release from the heavy national and municipal taxation which is directly attributable to social services, this country could compete very satisfactorily in the markets of the world with other nations, and might then be able to find employment for nearly the whole of its population.

Labour.

The year was without a single serious labour trouble, but not without a great labour problem. Lord Melchett continued to press forward with his—the Mond-Turner—scheme for a National Industrial Council, but its present position and its future is still rather obscure. Many engineering employers continue to look upon it with distrust. They fear that the conferences between employers and employed will lose, in time, their informal character, and that, at them, agreements and understandings reached by the Engineering Employers' Federation and the trades unions may be upset. It is feared, even, that the scheme may ultimately become a Parliament of Labour which will dictate terms to trades unions and employers. It is, perhaps, too early to find full justification for these forebodings. The plan, although it has been under discussion for just twelve months, the first general conference having taken place on January 12th, is not yet in full swing; the details of the organisation are meeting with obstacles; some of the trades unions look upon it with little favour and a good many employers are either opposed to it or indifferent. Whilst it would be wrong to say that no progress was made with it during the year, the fact remains that it is still far from completion.

Safeguarding.

Throughout the last six months the depressed state of the heavy iron and steel industries and the large importations of foreign iron and steel—amounting during the year to almost three million tons—led to active propaganda for a safeguarding tariff. The problems involved are extremely difficult. Could we say with certainty that safeguarding would effect a rapid and great improvement in the iron and steel industries, then no economist would permit tradition to stand in the way of its immediate introduction. But with the exception of very ardent advocates, who are in fact tariff reformers, there are relatively few who do not recognise that it would be little more than an experiment and that failure would not be impossible.

It is believed that as the result of the exclusion of foreign iron and steel by an adequate tariff the home trade would be increased and that the iron and steel works would be able to produce more cheaply owing to the greater amount of work passing through them. If Great Britain could live upon her home industries that argument would have as much weight as it has, let us say, in the United States. But it will avail the iron and steel industries of this country nothing at all if, whilst they are saving the home, they lose their foreign market. Let us assume that a million tons of iron and steel comes to us from Belgium at an average price thirty shillings below that asked by British producers. Dare we assume that Belgium will quietly accept that reduction of output if we exclude her from the British market? Certainly not. She will redouble her efforts in open markets and seize upon some—she has already gained a firm footing in India—which we now enjoy. We fear, therefore, that the first effect of putting up a barrier against Belgian iron and steel would be a reduction in our foreign trade not far short of, and possibly as great as, the augmentation of our home trade.

If, however, we could assume—and it is here that safeguarding is experimental—that, for a year or two, the tariff kept foreign iron and steel out of Great Britain without seriously diminishing our foreign trade—a large assumption—then, owing to the better conditions, work could be produced at a more competitive price and the improvement of works plant could be carried out on profits gained, with the result that a further drop in the cost of production would follow. As at the same time Belgium's prices would have risen in consequence of the reduction of her output a nearer approach to parity of price on foreign markets might be attained.

There is, unfortunately, much in this line of argument which is purely speculative. It might work out that way; it might not. Furthermore, it is not impossible that the same end could be attained without the introduction of safeguarding. It is not long since "rationalisation" was the "slogan" of iron and steel reformers. They showed that it was very greatly needed and indicated the improvements that would come in its train. Rationalisation has begun on a large scale within the past few months, and unless the prophets

are woefully at fault the results of it should begin to show this year. If they do, foreign competitors will find it difficult to compete in our home markets and the safeguarding tariff, did it exist, would automatically become inoperative. We may recall that the steel rebate scheme in the shipbuilding industry introduced by a group of steel manufacturers has had the effect of putting an end to the importation of foreign steel for ships, and, we understand, that in the last few weeks the tale of adherents to the scheme amongst shipbuilders has been made complete.

There can be no doubt at all that the iron and steel industries of this country stand in need of reform; many of the works are old; the management of some lacks vitality; and in nearly all the principles of economy have not been carried to the useful limit. We have a few works second to none in the world when our conditions are remembered, but we have too many which leave a great deal to be desired. Rationalisation by cutting out dead branches and by concentrating orders in the better works and thereby enabling them to operate nearer to capacity should effect a great reduction in price. More money is indeed needed, but we believe it will be found once there are real indications that reforms are being seriously undertaken and that both weak men and indifferent machines are being ruthlessly cut away. If a period of safeguarding could bring that event nearer we should be the first to welcome it, and we rejoice to know that the whole condition of the iron and steel industries of this country is to receive the consideration of the Government. But we must express quite definitely the opinion that no safeguarding which has the effect of stabilising prices at a high level, as in America, will avail us here. A home market is not sufficient to us. We must have a large foreign trade, and that can only be secured and maintained by production at a price which enables us to compete on favourable terms with steel makers of other nations. Only by such means can we ensure that when the day comes, as it undoubtedly will, for international co-operation amongst steel producers, this country shall receive that proportion of the world trade to which its favourable geographical situation entitles it.

A New Life.

During the year there were several important changes in the constitution of great firms. Amalgamations of conflicting interests were effected, redundant factories and plants were cut away and finances were put on a sounder footing. The old order is changing. We cannot help witnessing with regret the passage of individual firms whose names were household words, but we are compelled to admit that, since prudent amalgamations may reduce the costs of manufacture whilst preventing insensate competition, they will in the end make for the greater stability and prosperity of the engineering industries of Great Britain.

But these physical changes are not sufficient, in themselves alone, to secure success. As always the man counts more than the method, and unless great leaders are conjoined with them, we shall not reap the harvest that we have sown; the good seed in these newly constituted firms will not ripen into fruit. Here and there we have men of vision and energy, but there are still too many who are content to lead a humdrum existence, and to trust rather to the natural momentum of their business than to seek means of propelling it forwards. We see, for example, a greater inclination than ever to purchase licences to manufacture from foreign inventors, as thereby the cost of development and the anxiety of design are removed. We cannot regard that attitude with equanimity. It has an adverse effect upon our reputation as engineers, and it is hardly conceivable that purchasers, when they have the option, will buy from licencees when they can buy from the licensors. Moreover, it is saddening to think that a nation which at one time was the most prolific in the whole world of great inventions should cease to occupy that proud position. May we express an earnest hope that amongst their activities the firms which have been strengthened by amalgamations and reorganisation will not forget the development of British inventions.

We have often wondered if British engineering firms take half the trouble to press their products upon foreign markets that foreign firms, particularly the German and Swiss, take to advertise themselves in this country. Situated as we are at the receipt of a vast mass of literature, we are often impressed by the admirable bulletins and publications in our language which are circulated by continental firms, either individually or by groups for propaganda purposes. As far as we know, little or nothing of the kind is done by British engineers. Every year we prepare many thousands of reprints of our articles in convenient form for circulation, but only once, over a long period, have we been asked to do one into a foreign tongue. The excuse that such things are costly or that English is widely read by foreigners, carries little weight. The propaganda effected by such means cannot be measured by immediate expenditure or balanced by the probability that the people really interested will read English. We may remind our readers that a monthly magazine entitled *Engineering Progress* is regularly published in Germany for circulation in English-speaking countries. If there is no need for us to do anything on that scale, it is certainly desirable that in a smaller way efforts should be made to keep the progress of British engineering before foreign countries.

The Government and Industry.

During 1928 the Government made only one, outstanding, effort to help industry. We venture to congratulate it upon a restraint which must have been difficult in the circumstances. Speaking generally, Government help means higher taxation, and at the moment the greatest need of the country is a diminution of national and municipal imposts. The one action of the Government was the de-rating scheme introduced by the Chancellor of the Exchequer in the spring and put into operation as far as the railways are concerned a few weeks ago. The immediate effect is not good. The railways have reduced their freights, but so far there is quarrelling about the partition of the benefit. For example, the coke furnace proprietors claim it all, the pig iron producers do likewise, and the iron purchaser expects it all to be taken off the price. A detail of this kind need not give us much anxiety. It will gradually right itself. In principle the de-rating scheme is sound, and it will, we are confident, make good in the end. It is one of those measures in which a Government has carried out what every thoughtful person recognised to be desirable. But as a rule it is better for Governments to leave industries to "dree their ain weird," at the same time hampering them as little as possible by taxation and regulations. The British engineering industries are so well founded, they are so consonant with the natural genius of the people, the conditions are so favourable for their development and progress, that with the right men to guide them, they are most likely to succeed when left to themselves. Let other industries cry to the Government for help when they are faced by difficulties. The engineering industries ask no more than that they should be left to work out their own salvation, unhampered by legislation. If the Government desires to help it has ample scope in the pursuit of international arrangements which facilitate trade and in the search for means of making the British Empire a union of countries as homogeneous as the states of America. With a whole empire to serve, there should be no single unit—so diverse are their products and potentialities—which could not take its part in the upbuilding of an economic structure, the like of which has never been seen.

Conferences and Exhibitions.

Each year, as it comes, brings with it an ever-increasing crop of conferences and exhibitions at home and abroad. The strain which such events put upon the time and pockets of business and professional men is considerable, and complaints of their frequency are becoming audible. It is asked, "What is achieved by unwieldy conferences at which more papers than can possibly be dealt with thoroughly are presented for discussion?" The question is not easy to answer. Stress may be laid upon the social advantages of such gatherings, but that advantage disappears when the same people meet over and over again at successive meetings. Those who have something to advertise—as some of the authors invariably have—may welcome a large audience, but it is very doubtful if the members gain more from the discussions than they could get at far less expense from their technical Press and the book literature of the day. The conference habit is, in a sense, the lazy man's habit; the habit of the man who will not take the trouble to read, but will listen to a discussion or attend a lantern lecture. If one quarter of the time that is spent on travelling to and from and attending conferences was devoted to reading and writing more useful work would be done. An occasional conference for a specific purpose is an admirable thing; a plethora of conferences defeats its objects by a surfeit. An example of a right and fitting conference was that convened by the Institution of Civil Engineers in June in celebration of its centenary. Like all, it was overburdened with papers, but the occasion was a great one, and it was entirely proper that the Institution should invite representatives of other great institutions at home and abroad to celebrate with it the hundredth anniversary of its first Royal Charter. It is not against such conferences that complaints are directed, but rather against those that multiply themselves year after year with insufficient reason.

Something of the same kind is heard with regard to international exhibitions. The cost of exhibiting is very heavy indeed, and does not by any means invariably bring back an adequate return. Yet the fear of being outclassed by a competitor impels many firms to take space and to spend great sums on display. We do not say that 1928 was worse than preceding years in respect of either conferences or exhibitions, but we observed during it a keener criticism of such things than ever before, and it was even stated at one time that one famous annual exhibition would in future be held bienially.

Technical Advance.

There will be found in pages of this and succeeding issues detailed accounts of the work of engineers in various branches throughout the year. With the exception of electrical engineering, which shows steady advance in the size of generators, turbines and accessories, there is relatively little notable technical progress to put on record; but in volume of output there was during the year marked progress in several directions, particularly those associated with transport. The motor car industry flourished in a manner that gives surprise when the alleged poverty of the country is considered, and the oil marine engine for marine propulsion showed a great advance in numbers. But the most remarkable position is that of the light aeroplane. One firm is now turning out a machine a day, another is working up to its capacity of three hundred a year, and a third has an almost similar output. Thus between these three firms alone almost a thousand aeroplanes a year are produced, and they do not represent anything like the whole industry. It seems not improbable that in the current year no less than two thousand machines will be built in Great Britain alone principally for private owners. Not all of them will remain in this country. America and, probably, other nations are building on a somewhat similar scale. The unhappy visions of overcrowded skies with which pictorial prophets have made us familiar seem to be taking on a real substance. Even the railways, determined not to be caught napping in the air as on the road, are interesting themselves in flight and are seeking powers to run cross-Channel aeroplane services.

In steam engineering the most notable advance is in the increasing adoption of higher pressures and, with them, higher temperatures. So far 750 deg. Fah. has been recognised as the limit at which the materials available can be safely operated, but one firm at least is engaged upon a contract which involves the use of 1000 deg. Fah. Fortunately, metallurgy is one of the youngest and the most active of our industrial sciences, and through its agency we have every reason to believe that as each year goes by it will leave behind it a material which satisfies the demands of advancing thought in the science of heat engines.

Machine tools showed only one sign of departure from accepted practice, but no one who examined the tools at the Machine Tool Exhibition in September last could fail to be impressed by the patent fact that the machine tool has become an engineering product of the highest class and that it incorporates the most advanced knowledge of materials and of workshop methods of the day. The one direction in which a departure from standard practice was visible was the introduction of hydraulic or pneumatic operation. Whilst not strictly new—hydraulic operation of lathes was used during the war—it is now entering upon the commercial stage and there are not wanting those who say that for certain purposes it will be very largely used in the future.

Civil Engineering.

In civil engineering a great deal of work was completed during the year on docks, dams and bridges. With some of this work we shall deal in a later issue. Amongst the bridges brought to completion in this country is that connecting Newcastle and Gateshead, which was opened on October 10th and described in our issues of February 24th and October 12th. It is a miniature in a sense of

the huge structure which is being erected at Sydney, N.S.W., and its construction may be regarded as a dress rehearsal of the far more impressive work of erecting the superstructure of the Australian bridge which should be begun this year. Another bridge of a totally different kind which figures to the credit of the year is that which spans the Tweed at Berwick not far from its ancient brother. The new structure, which is in armoured concrete, was described in our issue of May 18th. At Glasgow another concrete bridge, the George V., was opened in February. The problem of London bridges continued to cause active discussion throughout the year, but up to the last moment a final decision had not been made. It was, however, decided that Waterloo Bridge is to be rebuilt and widened, but the final arrangements depend upon the decision reached with regard to the erection of a new bridge at Charing Cross, the removal of the Southern Railway terminus to the south bank of the river, and the site of a proposed bridge near St. Paul's with its approaches. Much discussion turned upon this problem, as many people fear either danger to the amenities of the Cathedral or even to its structure. It would take more space than we can afford to mention even by name great civil engineering works carried out abroad, but we cannot conclude without mentioning the vast development of hydraulic power which is taking place in Canada. So frequent are the openings of new power stations or the development of increasing stations that it is difficult to keep pace with them, but we have endeavoured throughout the year to keep our readers informed of this very notable development of the Empire's resources.

Locomotives of 1928.

THE past year has not to its credit the appearance of any notable locomotives of normal design. It saw, however, the continuation of the development of the extra high-pressure engine and interest in powdered fuel burning—almost forgotten since Mr. Robinson's experiments on the Great Central in 1918–19, was revived by the appearance of an A.E.G. design, in which very short transverse flames are employed. With a single exception—the Kitson-Still oil-steam locomotive—all the progress in new lines is being made abroad, neither the four railway companies nor the private builders having yet broken away from conventional forms, though it is an open secret that Mr. Gresley is busy on a new high-pressure locomotive with a Yarrow boiler.

The two outstanding novelties of the year are the Kitson-Still engine and the Winterthur 850 lb. engine. The former ran her trials at the end of April, and an account of them was given in THE ENGINEER of May 4th. The route, Leeds-Wakefield, selected for the tests was not one for which the engine was designed, yet the results were promising. Subsequently she was put in other services on the London and North-Eastern Railway and recently has been tested with a dynamometer car. The trials have revealed certain peculiarities which are now being investigated, and when necessary modifications have been made the engine will again take the road.

The Winterthur locomotive, built by the Swiss Locomotive and Machine Works, belongs, strictly, to 1927, but her trials were made in January last by the Swiss Federal Railways, and interest in her design was aroused by the full description given by Dr. Herbert Brown at the centenary celebrations of the Institution of Civil Engineers. The engine was dealt with at length in THE ENGINEER of December 14th, 1928. She is characterised by the use of a water-tube boiler of novel design, and a three-cylinder high-speed horizontal engine placed under a hood at the front end, and geared down to a lay shaft which drives the coupled wheel through the medium of connecting-rods. The boiler consists of a single, large-diameter, steam drum connected by vertical tubes to two smaller water drums. Longitudinally the boiler is divided into three almost equal portions by two narrow water walls pierced by numerous short tubes and other openings where necessary. One of these compartments forms the fire-box, the next the combustion chamber, containing the superheater, and the third the smoke-box, in which a preheater for the fire-box air is fitted. Several British locomotive engineers have seen the engine, and, we understand, are favourably impressed.

The system of powdered fuel burning mentioned above is the invention of the Allgemeine Elektricitäts Gesellschaft, and was illustrated in THE ENGINEER of November 2nd, 1928. The locomotive fitted with it is of normal design, the only modifications required being the lining of the lower part of the fire-box with refractory bricks, the placing of the burners in position, and the attachment of a cylindrical container for pulverised fuel with mechanism for conveying the fuel to the burners. The burners themselves are horizontal rectangular troughs with vertical slots in one face. They are placed *vis-a-vis* and the coal is blown towards the centre, the flames from one side meeting those from the other. In a standard-gauge narrow fire-box the space between the burners is not more than 2ft., but complete combustion appears to be effected. A Southern Railway locomotive is to be fitted with the appliance for a test with English coal.

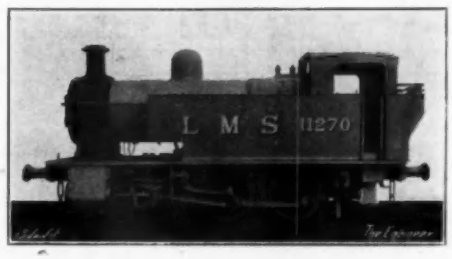


FIG. 2—L.M.S. TANK ENGINE

Great Western Railway.

During the year 149 new engines were put into service on the Great Western Railway, some being made at Swindon, some by Armstrong, Whitworth and Co., and some by the North British Locomotive Company, Ltd. The most interesting engine introduced a new class, the "Halls." These are two-cylinder 4–6–0 locomotives with 6ft. wheels. The cylinders are 18½in. diameter with the exceptionally long stroke of 30in., and, as will be seen from the photograph reproduced in a Supplement this week and the diagram herewith—Fig. 1—drive on to the middle pair of coupled wheels. The engines—five have already been built—are fitted with standard No. 1 boilers working at 225 lb. The tractive effort is 27,275 lb. and the weight, engine and tender, in running order, 115 tons. Eighty engines of the type are to be constructed at Swindon.

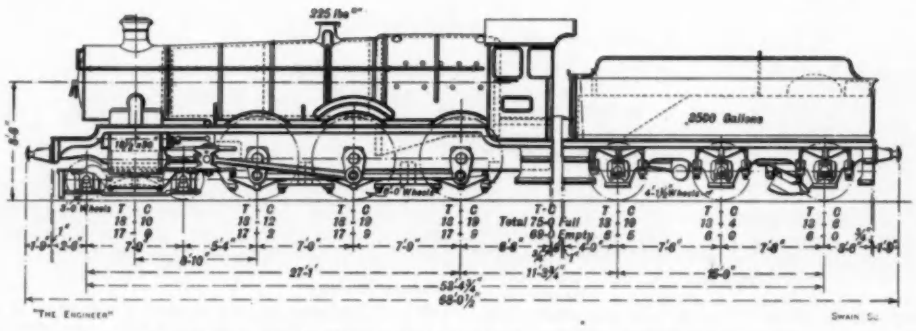


FIG. 1—G.W. RAILWAY—"HALL" CLASS PASSENGER ENGINE

London, Midland and Scottish Railway.

During the year eighty-nine engines of the 0–6–0 No. 4 class tender goods engines were built by the L.M. and S. Company at Crewe, Horwich and St. Rollox; ten 2–6–0 mixed traffic engines were built at Crewe, and twenty-one No. 4 class 2–6–4 passenger tank engines; fifty No. 2 class 4–4–0 passenger tender engines and ten dock shunting engines were turned out at Derby; whilst 150 No. 3 class 0–6–0 goods tank engines were purchased from contractors. Besides these new constructions twelve 2–8–0 goods tender engines bought from the Government in 1927 were reconditioned and put into service.

The fifty 4–4–0 passenger tender engines referred to above are a modification of a Midland design, the cylinder diameter having been reduced from 20½in. by 26in. to 19in. by 26in. and the driving wheel diameter from 7ft. 0½in. to 6ft. 9in., whilst the boiler pressure has been raised from 160 lb. to 180 lb. The new engines are admirably suited for the hauling of passenger trains, other than the heaviest expresses, on all parts of the company's system. We may add that three of them have been allocated to the Somerset and Dorset line.

The little dock engines, Fig. 2, have been designed as shunting tank locomotives, especially suitable for goods yards and docks. As they have to take very sharp curves the wheel base has been kept down to 9ft. 6in. and the trailing axle is given ½in. side play. The boiler is a standard design.

To most people the modified Claughton, which is illustrated in one of our Supplements to-day, will be more interesting than these bread-and-butter engines. The modification consists in the use of a larger boiler, but the original four simple-expansion cylinders remain. From the little table given below it will be seen that the new boiler is 3in. greater in diameter than the old one, and that the fire-box is a little bigger than it was.

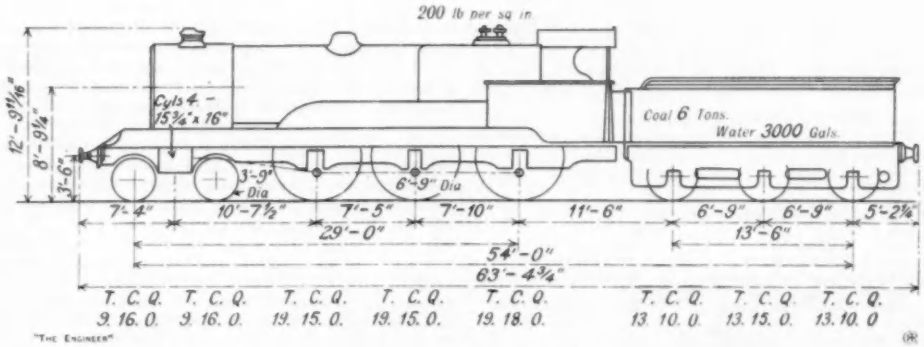


FIG. 3—L.M.S. RAILWAY—MODIFIED "CLAUGHTON" LOCOMOTIVE

	New boiler.	Old boiler.
Maximum diameter of barrel outside	5ft. 5½in.	5ft. 2in.
Length between tube plates	14ft. 0in.	14ft. 10¼in.
Height of centre from rails	8ft. 9½in.	8ft. 9in.
Heating surface, square feet—		
Small tubes	1088 (140×2½ OD)	1087·9 (149×1⅞ OD)
Large tubes	462 (24×5½ OD)	486·3 (24×5¾ OD)
Fire-box	183	174·5
Total	1733	1748·7
Superheater (24 elements)	365	379·3
Combined heating surface	2098	2128·0
Grate area	30·5	30·5
Boiler pressure, lb. per sq. in.	200	175
Tractive effort (at 85 per cent. boiler pressure), lb.	27,577	23,687

As a whole, however, the combined heating surface is smaller, but the pressure has been raised from 125 lb. to 200 lb., and, in consequence, the tractive effort at 85 per cent. is now 27,577 lb., as against 23,687 lb. A weight diagram of the modified engine is given below, Fig. 3. The weight, owing to the larger boiler, has risen from 117 tons to 119 tons 15 cwt. Nineteen of these engines have now been provided with these boilers and nine of them have the Caprotti valve gear. As the first gear of that kind on the L.M. and S. is on a Claughton there are now ten engines of that class fitted with it. The larger boiler will be fitted to the first engine in due course.

London and North-Eastern.

There is nothing of very special interest to record so far as locomotive work on the London and North-Eastern during the year 1928 is concerned, beyond the introduction of the non-stop run from London to Edinburgh on May 1st. In order to enable enginemen to change *en route*, corridor tenders were fitted to the engines required to work this train, of which drawings were published in our issue of June 15th. During the year orders were received to construct ten more "Pacific" engines, of which several are already in traffic. A photograph of one of these engines with a corridor tender is reproduced in a Supplement to-day. The principal difference between these engines and the previous "Pacifics" is the fact that, in conse-

quence of the boiler pressure having been increased to 220 lb. per square inch, the cylinders have been reduced in diameter from 20in. to 19in. All of them are fitted with long-stroke valve gear.

Since the formation of the London and North-Eastern group company in 1923 no new express passenger engines had been built for the Great Eastern Section. There is a considerable development in the passenger traffic over this section of the line, but owing to the bridges not being up to the same standard as those over the main line from London to Scotland, engines of the "Pacific" type cannot at present be allowed to work over it. Mr. Gresley therefore prepared a design of a three-cylinder engine, 4–6–0 type, for working on this section of the railway, and one of the class is illustrated in a Supplement to-day and by the diagram herewith—Fig. 5. Ten engines of this type are being built by the North British Locomotive Company; three are already in service. Owing to the improved balancing and reduced hammer-blow which can be obtained with the three-cylinder arrangement the engineers of the company are prepared to accept an engine of this type having 18 tons on each of the axles, whereas with engines of the 4–6–0 two-cylinder type, which are at present running on the Great Eastern Section, the weights on the coupled wheels are restricted to 15 tons 13 cwt., 13 tons 12 cwt., and 14 tons 3 cwt. respectively. It was stipulated that the overall length of the new engine should be approximately the same as that of the old engines; hence the small type of tender which is used on the Great Eastern Section is used in place of the standard type of the London and North-Eastern. With these new engines the boiler is of more ample proportions than on the old engines, and the total weight has been raised from 63 tons to 76 tons 13 cwt. The grate area has been increased from 26½ square feet to 27½ square feet, the evaporative surface from 1632 square feet to 1676 square feet, the superheater surface from 202 to 344 square feet, and the working pressure from 180 lb. to 200 lb. The cylinder horse-power is now 1653 instead of 1295, and the tractive effort at 85 per cent. 24,379 lb., as against 21,969 lb.

At the front end the arrangement is somewhat similar to that of the "Royal Scot," in that the middle cylinder drives on the front coupled axle, whereas in all Mr. Gresley's other three-cylinder engines all the cylinders drive on the second coupled axle.

There is no inside valve gear, as Mr. Gresley was able to apply his arrangement of valve gear to the back side of the cylinders, as in the "Shire" class engines which were built in 1927. Hence there is no inside valve motion, which is somewhat difficult to get at with this type of engine, if it is placed under the smoke-box, as it must be if the inside cylinders are well forward and drive on to the front coupled axle. The connecting and coupling rods are of nickel-chrome steel of similar design to those used on the "Pacific" engines. A table of dimensions and ratios is given herewith.

During the year 1919 a 2–6–0 engine was fitted up with Ransome and Marles' roller bearings throughout the valve gear, and after running 88,000 miles only two pins had to be renewed and one roller race. With this exception the bearings were replaced and the engine is still in service. The results with this engine were regarded as sufficiently satisfactory to justify the extension of the use of roller bearings in connection with locomotive valve gears, and last year Mr. Gresley fitted up one of the "Pacific" engines with Ransome and Marles' roller bearings for the valve gear. This is an interesting and important advance, and we reproduce some drawings, Fig. 4, showing the application of these bearings to different parts of the motion. On each point a nipple is fitted by which a grease gun, such as is used on motor cars, can be applied for forcing grease into the bearing. It is anticipated that it will only be necessary to do this once each month instead of the enginemen having to fill the oil cups at each of these points every day. It is expected that the use of roller bearings will result in the reduction in the cost of maintenance and lubrication, and that, owing to the absence of wear, the correct steam distribution will be maintained.

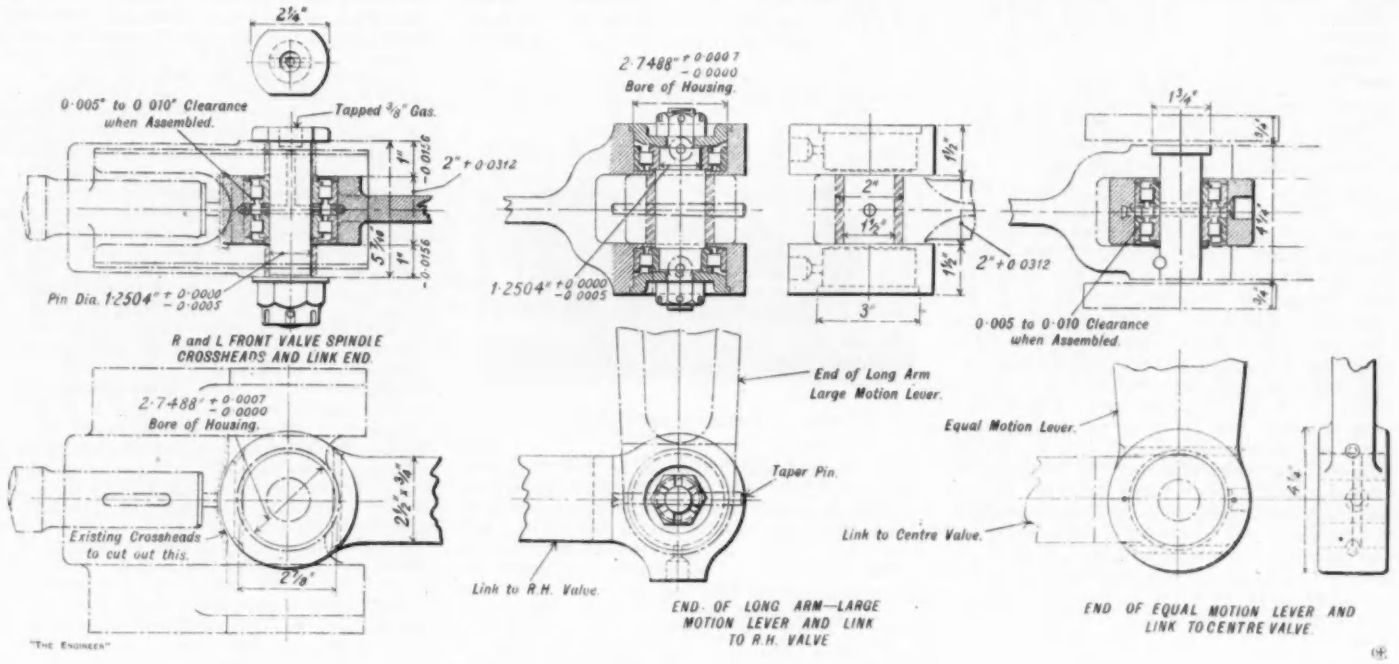

0·005" to 0·010" Clearance when Assembled.
Tapped ⅜" Gas.
Pin Dia. 1·2504" +0·0000 −0·0005
R and L FRONT VALVE SPINDLE CROSSHEADS AND LINK END.
2·7488" +0·0007 −0·0000 Bore of Housing.
Existing Crossheads to cut out this.
"The Engineer"
2·7488" +0·0007 −0·0000 Bore of Housing.
1·2504" +0·0000 −0·0005
End of Long Arm Large Motion Lever.
Taper Pin.
Link to R.H. Valve.
END OF LONG ARM—LARGE MOTION LEVER AND LINK TO R.H. VALVE
0·005 to 0·010 Clearance when Assembled.
Equal Motion Lever.
Link to Centre Valve.
END OF EQUAL MOTION LEVER AND LINK TO CENTRE VALVE.

FIG. 4—L. AND N.E. RAILWAY—ROLLER BEARINGS

L. and N.E.R. Three-Cylinder Engine—Leading Particulars.

Grate—	
Length on slope	8ft. 3⅛in.
Width	3ft. 4⅛in.
Grate area	27·5 square feet
Fire-box—	
Height of crown above foundation ring:	
Front	6ft. 1⅛in.
Back	5ft. 0⅛in.
Interior length at top	8ft. 2⅛in.
Interior width at boiler centre	4ft. 7⅛in.
Thickness of copper plates:	
Sides and back tube plate	⅜in., 25/64in., and 1in.
Boiler—	
Outside length fire-box overall	10ft. 0⅛in.
Outside length fire-box at bottom	8ft. 11in.
Outside width fire-box at bottom	4ft. 0⅛in.
Diameter of barrel, maximum	5ft. 6in.
Length of barrel	13ft. 6in.
Thickness of barrel plates	⅜in. and ⅝in.
Thickness of wrapper plates	⅛in.
Outside diameter of smoke-box	5ft. 9⅛in.
Outside length of smoke-box	5ft. 5⅛in.
	Robinson superheater
Tubes, small—	
Material	Steel
Number	143
Diameter, outside	2in.
Thickness	12 I.W.G.
Tubes, superheater flue—	
Number	24
Diameter, outside	5⅛in.
Thickness	5/32in.
Length between tube plates	14ft.
Heating surface—	
Fire-box	168 square feet
Tubes, 2in.	1048 square feet
Flues	460 square feet
Total evaporative heating surface	1676 square feet
Superheater—	
Number of elements	24
Diameter, inside	17/32in.
Heating surface	344 square feet
Total heating surface	2020 square feet
Two Ross pop safety valves	3in. diameter
Working pressure	200 lb. per square inch
Boiler horse-power	1230
Axles, diameter and length—	
Journals, bogie	6⅛in. by 11in.
Coupled wheels	9⅛in. by 11in.
Crank pins, outside	5⅛in. by 6in.
Crank pins, inside	6in. by 8⅛in.
Coupling pins, leading	4in. by 4⅛in.
Coupling pins, driving	6in. by 4⅛in.
Coupling pins, trailing	4in. by 5in.
Springs—	
Bogie: Helical, 10 5/16in. long, free, 5 1/16in. outside diameter, Timmis section.	
Coupled wheels: Laminated, 3ft. 6in. centres, nine plates, 5in. wide by ⅜in. thick.	
Cylinders (three)	17½in. dia. by 26in. stroke
Cylinder horse-power	1653
Motion—	
Type, outside	Walschaerts
Type, inside	Gresley
Type of valve	Piston
Diameter of valve	8in.
Maximum travel of valves	5⅛in. + 1/32in.
Steam lap	1⅛in. outs., 1 1/16in. ins.
Exhaust lap	Nil
Cut-off and full gear	65 per cent.
Tractive effort at 85 per cent. boiler pressure	24,379 lb.
Total adhesive weight	120,400 lb.
Adhesive weight ÷ tractive effort	4·93

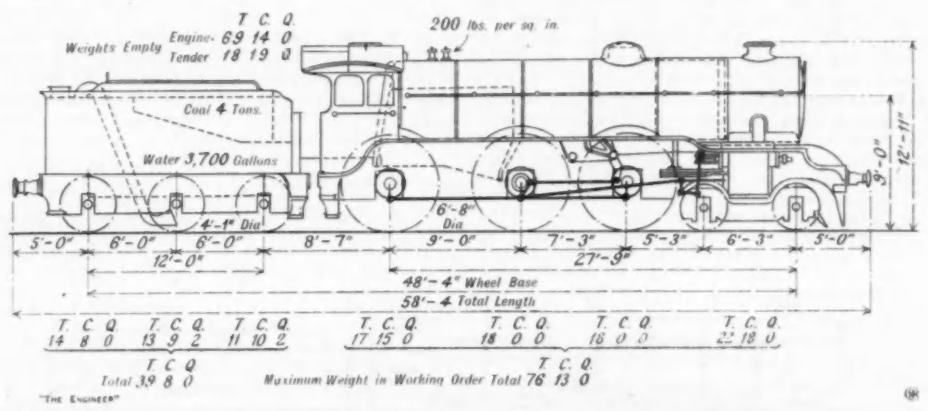

T. C. Q.
Weights Empty Engine 69 14 0
Tender 18 19 0
200 lbs. per sq. in.
Coal 4 Tons.
Water 3,700 Gallons
4'-1" Dia.
6'-8" Dia.
5'-0" 6'-0" 6'-0" 8'-7" 9'-0" 7'-3" 5'-3" 6'-3" 5'-0"
12'-0"
27'-3"
48'-4" Wheel Base
58'-4" Total Length
9'-0"
12'-11"
T. C. Q. 14 8 0 | 13 9 2 | 11 10 2 | 17 15 0 | 18 0 0 | 18 0 0 | 2' 18 0
T. C. Q. Total 39 8 0
T. C. Q. Maximum Weight in Working Order Total 76 13 0
"The Engineer"

FIG. 5—L. AND N.E. RAILWAY—THREE-CYLINDER PASSENGER ENGINE

Southern Railway.

During the year ten 4–6–0 passenger engines of the "Lord Nelson" class were practically completed and seven were put actually into service. An order for a further five engines will bring the total number of engines of this class to sixteen by the end of the present year.

The last engine of a batch of fifteen mixed traffic 4–6–0 type, Class "S. 15," was completed at Eastleigh and ten passenger engines of the 2–6–0 type, Class "U," were built at Brighton, while two engines of the same class of an order of ten were turned out at Ashford works.

The first of an order of eight three-cylinder shunting tank engines of the 0–8–0 type was nearly completed at Brighton. Eight more of the Stroudley 0–6–0 type tank engines, Class "E¹, Central Section," are being altered to 0–6–2 type for working the Torrington-Hallwill branch.

New work in hand included five three-cylinder mixed traffic engines of the 2–6–0 type with 5ft. 6in. wheels, ten three-cylinder passenger engines of the 2–6–0 type with coupled wheels 6ft. diameter, and ten large three-cylinder engines of the 4–4–0 type of a capacity approaching that of the "King Arthur" class engines, and intended to work the Eastern section of the line.

BRITISH MAKERS' ENGINES.

The Avonside Engine Co., Ltd.

It is reported by the Avonside Engine Company, Ltd., of Bristol, that the year was a comparatively quiet one, though a fair degree of activity was maintained.

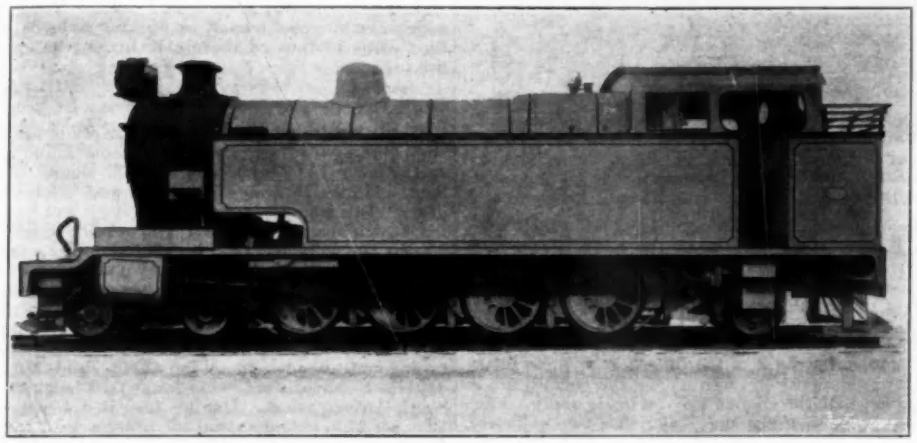


FIG. 6—TANK ENGINE FOR SOUTH AFRICA—AVONSIDE

The largest locomotive constructed—Fig. 6—was built to the order of the Tweefontein United Collieries, South Africa, the gauge being 3ft. 6in. The locomotive is of the 4–8–2 type with outside cylinders 20in. diameter, 24in. stroke, coupled wheels 3ft. 10in. diameter, boiler pressure 175 lb. per square inch, and tractive effort on usual basis of 85 per cent. boiler pressure, 31,043 lb. The side tanks have a capacity of 1750 gallons and the bunker capacity is 4½ tons.

Amongst other contracts in hand is one for a batch of eleven 0–6–0 saddle-tank metre-gauge locomotives for service in connection with the construction of the Singapore Naval Base. The cylinders are 12in. by 18in. and the coupled wheels 2ft. 11in. diameter. The total heating surface is 453 square feet, and the grate area 6½ square feet. In addition to the locomotives described above, a number of standard design shunting engines of various types were completed and delivered.

W. G. Bagnall, Ltd.

This Stafford firm is able to make the very satisfactory report that it was engaged up to capacity throughout the year. The principal work comprised the construction of seventeen goods tank engines for the L.M. and S. and Somerset and Dorset Railways; six tank engines with 15in. by 23in. cylinders for the Nigerian Railways; two 4–6–0 tender engines with 16½in. by 22in. cylinders for the Assam Railways and Trading Company; and five 0–6–2 tank engines of new design for the Federated Malay States Railways. The last-named engines are designed especially for shunting and have cylinders 13in. by 20in., driving 3ft. 3in. wheels. Finally, we may mention and illustrate—Fig. 7—one of two new engines for the Indian States Railways, North-Western Section. They were built to the requirements of the Railway Board and are practically exact replicas of the large metre-gauge engines now being constructed, but on a 2ft. 6in. gauge. The Railway Board of India is standardising as far as possible all Indian locomotives of different gauges, and this is the first of a new type. The engines were constructed in accordance with the specifications and under the inspection of Messrs. Rendel, Palmer and Tritton of Westminster. They have 12in. by 18in. cylinders, 2ft. 10in. coupled wheels and 160 lb. working pressure at 85 per cent. of which a tractive effort of 10,039 lb. is developed. In working order the engines weigh 28½ tons and the tenders 16 tons. The tender carries 1300 gallons of water and 2¼ tons of coal. In working order the engine weighs 69 tons, of which 48 tons are carried on the coupled wheels.

The firm constructed also three narrow-gauge locomotives, 0–6–2, for service in India and South Africa on a 2ft. 6in. gauge. The cylinders are 10½in. diameter by 16in. stroke, coupled wheels 2ft. 9in. diameter, boiler pressure 180 lb. per square inch, and tractive effort on the usual basis 9430 lb. The side tanks have a capacity of 500 gallons and the bunkers of 1½ tons. The locomotive weighs 21 tons in working order. Some 0–4–2 engines were also built for service in India on a 2ft. gauge, with cylinders 9½in. diameter by 14in. stroke, coupled wheels 2ft. 6in. diameter, and working pressure 160 lb. per square inch, giving a tractive effort of 5430 lb. The side tanks of this engine carry 300 gallons and the bunkers 1 ton. The weight in working order is 16½ tons.

Beyer, Peacock and Co., Ltd.

Apart from a score of three-cylinder engines of normal design for the Buenos Aires Great Southern Railway and half a score of the Great Eastern type with Lentz valve gear, for the London and North-Eastern Railway, the most interesting work done by Beyer, Peacock and Co., Ltd., Manchester, during 1928 was the construction of "Garratt" engines of various sizes, some of them being on repeat orders. Three engines of this type for the New Zealand Government Railways have 4–6–2 units, each of which has three 16½in. by 24in. cylinders, with Gresley valve gear, with the cut-off fixed at 50 per cent. Their fire-boxes are fitted with thermic syphons, and as the grate area is about at the limit for hand firing, Duplex mechanical stokers are fitted. When full, these engines weigh 146 tons. The Buenos Aires Great Southern took, besides the normal engines mentioned above, twelve 4–8–2—2–8–4 "Garratt" locomotives, weighing 165 tons 12 cwt. in working order. They have 17½in. by 26in. cylinders and develop a tractive effort of 43,040 lb. at 75 per cent. of the boiler pressure, which is 200 lb. The driving wheels are 4ft. 7½in. in diameter. One of these locomotives is illustrated by Fig. 11.

R. and W. Hawthorn, Leslie and Co., Ltd.

The Forth Bank Works of Hawthorn, Leslie and Co., Newcastle-upon-Tyne, were fairly well employed during 1928 with orders for locomotives and boilers, both for home and foreign railways, amongst the locomotives delivered being a number of superheated main line passenger tank locomotives and several bar-framed oil-fired locomotives for South America. Special fireless locomotives and a combined shunting and crane locomotive were also built, as well as several electric locomotives, including two large engines for India, built in conjunction with electrical manufacturing companies.

A 4–8–0 locomotive for the Dorada Railway, Colombia, is illustrated by Fig. 9. The gauge is 3ft., the cylinders 17 by 22, the coupled wheels 3ft. 4in., and the working pressure 180 lb. At 75 per cent. of the boiler pressure the tractive effort is 21,458 lb. It will be noticed that the engine has a bar frame. It carries 2500 gallons of water and 1200 gallons of fuel oil. The evaporative surface is 1217 square feet and a superheater of 272 square feet is fitted.

Hunslet Engine Company, Ltd.

During the year the works of the Hunslet Engine Company, Ltd., Leeds, were kept fairly fully employed having regard to the prevailing conditions. Amongst the locomotives constructed were a further number of L.M. and S. 0–6–0 shunting engines of the latest type. For service abroad 4–8–0 tender engines of 5ft. 6in. gauge for the Ceylon Government Railways were built, particulars of which appeared in our issue of September 7th last. For the same Colony the company built 2ft. 6in. gauge superheated tank engines, 4–6–4 type, with cylinders 14in. diameter by 20in. stroke; wheel base, 23ft. 8in.; total heating surface, 816·5 square feet; weight in working order, 48 tons 7½ cwt.; and tractive effort, 13,066 lb.

The Hunslet Company had also a repeat order for a heavy type of 0–6–0 shunting engine for the Madras Port Trust, which we illustrate by Fig. 12. The gauge of the Trust's railway is 5ft. 6in. The

FIG. 7—NARROW GAUGE ENGINE FOR INDIA—BAGNALL

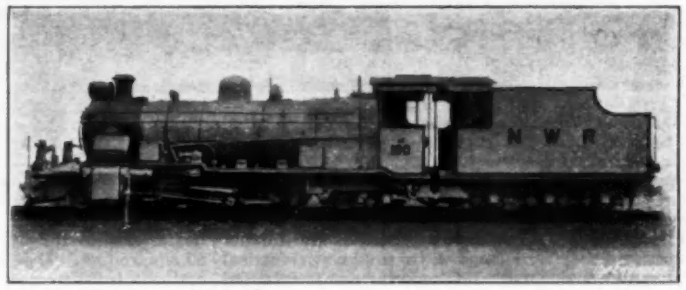


FIG. 8—NARROW GAUGE ENGINE FOR INDIA—NASMYTH WILSON

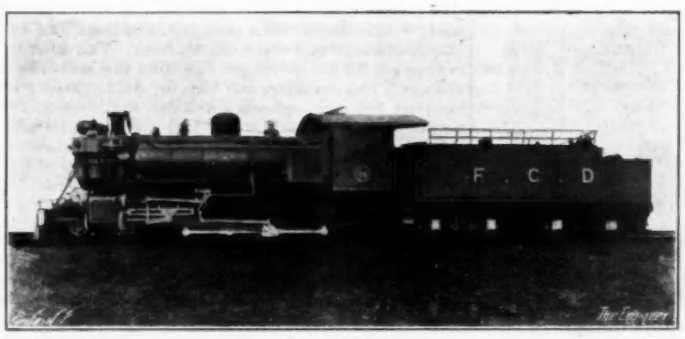


FIG. 9—NARROW GAUGE LOCOMOTIVE—HAWTHORN, LESLIE

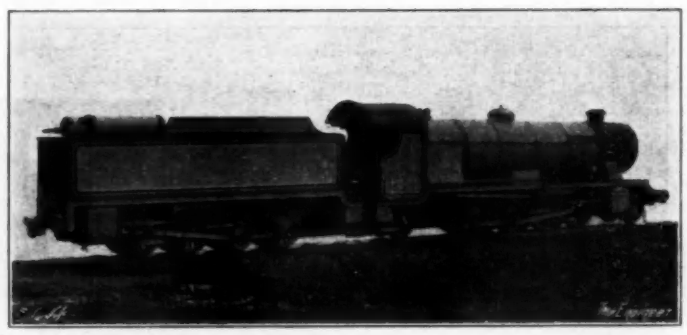


FIG. 10—15IN. GAUGE POULTNEY LOCOMOTIVE—YORKSHIRE ENGINE CO.

cylinders are 16in. by 24in., driving 3ft. 10in. wheels at a working pressure of 170 lb. The total heating surface is 791·5 square feet and the grate area 14·7 square feet. The saddle tank carries 1200 gallons, and in working order the engine weighs 47 tons 2 cwt. At 75 per cent. of the boiler pressure it develops a tractive effort of 17,030 lb., and will haul 900 tons on the level, 450 up 1 in 100, and 250 up 1 in 50.

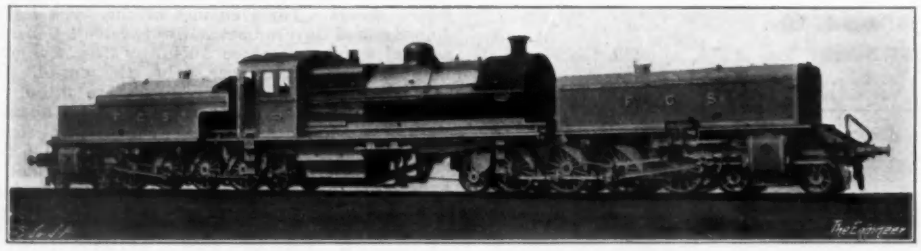


FIG. 11—GARRETT ENGINE FOR SOUTH AMERICA—BEYER, PEACOCK

Kerr, Stuart and Co., Ltd.

There was a fair output of locomotives of the smaller kind from the works of Kerr, Stuart and Co., Ltd., Stoke-on-Trent, amongst them being small geared locomotives of unconventional design and locomotives driven by heavy-oil engines. These engines have one thing in common; it is the use of vided with a cover so that inspection and cleaning may be readily carried out.

Kitson and Co., Ltd.

In our issue of November 2nd last we described and illustrated the two most notable locomotives which Kitson and Co., of Leeds, completed last year. They are Kitson-Meyer engines for the Kalka-Simla Railway, and are remarkable for their size and their extraordinary flexibility. Another engine of the same type but of different dimensions is shown by Fig. 13. It is one of a pair for the Ferrocarril de Cundinamarcha, Colombia. Now that railway is at present of the 3ft. gauge, but as it is the intention at some future date to enlarge it to metre gauge the engines are so designed that the change may be made easily. Each of the engines, under one boiler, has two cylinders,

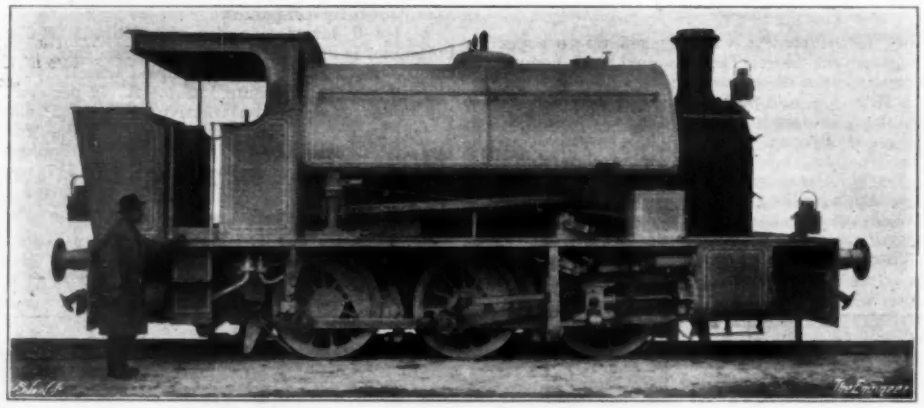


FIG. 12—SHUNTING ENGINE FOR MADRAS—HUNSLET

chains for coupling the driving wheels. A full description, with drawings, of the heavy-oil locomotive was given in THE ENGINEER as recently as November 23rd, to which issue we refer our readers for further details. The steam locomotive employs a vertical high-speed engine, with Hackworth valve gear, fitted in a rectangular box at the front end; at the back end is a vertical water-tube boiler, also enclosed in a rectangular casing, and joining the two is a horizontal cylindrical water tank. The weight of the locomotives with either four or six coupled wheels is 10 tons. With 300 lb. boiler pressure a tractive effort of 7400 lb. is developed. The boiler is interesting. It consists of a series of vertical headers joined by water tubes so that a rectangular mass of tubes is presented to the hot gases, whilst the walls formed by the headers which are extended downwards to the grate absorb the radiant heat. A cylindrical water drum is placed centrally at the top of the boiler, and to it the headers are connected by bent pipes which form a steam superheater or drier. One end of each cross tube is pro-

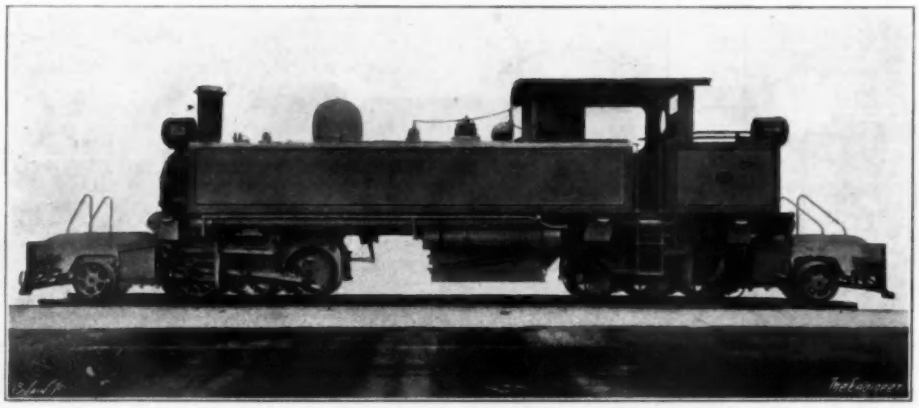


FIG. 13—KITSON-MEYER LOCOMOTIVE—KITSON

14in. by 18in., driving six coupled wheels of 2ft. 10½in. diameter with a boiler pressure of 160 lb. The total evaporative surface is 876·7 square feet, the superheater surface 160·5 square feet, and the grate area 27 square feet. The maximum axle load is 9·85 tons and the total weight with tanks and boiler full is 70·2 tons. The tanks carry 1753 gallons in all, and the coal capacity is 2½ tons.

Reference has been made in our opening remarks to the progress made by the Kitson-Still locomotive.

Nasmyth, Wilson and Co., Ltd.

Many locomotives for India were built by Nasmyth, Wilson and Co., Ltd., during 1928, included amongst them being four standard passenger metre-gauge engines fitted with the Caprotti valve gear for the Bengal and North-Western Railway. Several of the new standard metre-gauge engines of the "Y.B." and "Y.C." class were turned out, and two of the new standard 2ft. 6in. gauge "Z.E." type were built for the North-Western Railway of India. The last named is illustrated by Fig. 8. In working order the engine and tender weigh 64·8 tons. The cylinders are 16in. by 18in., the working pressure 160 lb., and the driving wheel diameter 2ft. 10in., giving a tractive effort at 85 per cent. boiler pressure of 18,432 lb. The "Y.C." locomotive is illustrated in one of our Supplements. Three of the type were built for the Madras and Southern Mahratta Railway and two for the Bombay, Baroda and Central India Railway. They have 17½in. by 24in. cylinders driving 4ft. 9in. wheels at a working pressure of 180 lb., the tractive effort at 85 per cent. being 19,729 lb. The grate area is 31 square feet, the evaporative surface 1448 square feet, and the superheater surface 322 square feet. The weight, engine and tender, in working order is 91·2 tons, with 12 tons as the maximum on the central driving axle.

North British Locomotive Co., Ltd.

We have selected from the large variety of locomotives built by the North British Locomotive Company, Ltd., during the year a mixed traffic engine for the South African Railways for illustration—see Supplement. This engine weighs over 105 tons and hauls a tender weighing 66 tons 2 cwt. The working pressure is 200 lb., the cylinders 23in. by 28in., and the coupled wheels 4ft. 9in. Hence the tractive effort at 75 per cent. is 38,970 lb. The boiler has an evaporative surface of 2775 square feet and the superheater has 690 square feet. The grate area is 48·3 square feet and the fire-box is of steel. Amongst other engines turned out, besides those for the L. and N.E.R., described above, were some large tank engines for South African mines. One of these is a 4–8–0 with 19in. by 27in. cylinders and the other a 4–10–0 with similar cylinders. The boiler is common to both sizes and the tractive effort the same, the engines only differing by the introduction of another pair of coupled wheels. They carry 1720 gallons of water in side tanks.

Peckett and Sons, Ltd.

During the year Peckett and Sons, Ltd., Bristol, built the little locomotive shown in Fig. 14 for the

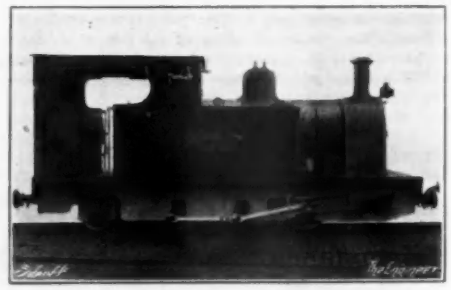


FIG. 14—TANK ENGINE FOR PERSIA—PECKETT

Anglo-Persian Oil Company, Ltd., for use in Persia. It is fired with the owners' oil, having a specific gravity of ·895 at 65 deg. Fah. The installation is of the Kermode type, but a hand pump and special burner are fitted to enable the locomotive to be started up from cold. All outlets from the storage tank are provided with stop valves for isolation in case of fire. The engine has to operate on a 32-mile stretch of line with 3-mile length of 3 per cent. gradient and two-thirds of a mile of 2 per cent. gradient. The minimum curves are 140ft. radius on the main line and 70ft. on sidings. The cylinders are 10in. by 15in. driving six-coupled 2ft. 6½in. wheels on a 2ft. 6in. gauge. The working pressure is 180 lb. and the tractive effort 7530 lb. at 85 per cent. of the boiler pressure. In working order the engine weighs 23½ tons.

Robert Stephenson and Co., Ltd.

The engine illustrated by Fig. 15 is one of ten which Robert Stephenson and Co., Ltd., of Darlington, are building for the Central Argentine Railway, the gauge of which is 5ft. 6in. It is a 2–8–2 cross compound with a 21in. by 26in. high-pressure and 31½in. by 26in. low-pressure cylinder. The driving wheels are 5ft. 2in. in diameter and the working pressure 200 lb. At 50 per cent. of this pressure the tractive effort is 18,498 lb. The total weight of engine and tender is 154 tons and the total length over buffers 66ft. 8in. The grate area is 27·9 square feet, the evaporative surface 1601 square feet, and the superheater surface 277 square feet. The tender carries 6000 gallons of water. Amongst other engines built by the firm were 4–6–0 metre-gauge locomotives for the Bengal and North-Western Railway, 4–8–0 metre-gauge engines for Tanganyika, and one engine for the Sudan Government Railway, 3ft. 6in. gauge. This is a large engine of the "Prairie" type with 21in. by 27in. cylinders and makes the twelfth of the design supplied to the Sudan, where they are doing excellent work. Five "Mikado" engines also went to the same destination and five 3ft. 6in. engines to the Nigerian Railways. To the Ottoman Railway, 4ft. 8½in. gauge, four 2–8–2 engines with 19½in. by 26in. cylinders were sent. They are

fitted with the Superheater Company's multiple valve regulator—see THE ENGINEER, March 23rd, 1928—with Weir feed heaters and Titan water purifiers.

The Vulcan Foundry, Ltd.

The report received from the Vulcan Foundry, Ltd., of Newton-le-Willows, like those from other builders, show that the locomotive building industry enjoyed fair prosperity during the year. With the exception of the completion of an order for thirty goods tank engines for the L.M. and S. Railway, practically all the work at Newton-le-Willows was for overseas and most of the engines were built to Indian standards. Many of them were of the largest size. For the N.W.R. work was begun on four experimental four-cylinder engines, two of which are to be fitted with the Caprotti and two with the Lentz valve gear. The company has also in hand the mechanical parts for thirty-one electric locomotives for which Metropolitan-Vickers, Ltd., are the main contractors. These handsome engines, one of which is illustrated in a Supplement to-day, are for the G.I.P. Railway.

Yorkshire Engine Co., Ltd.

The most interesting locomotive work done during the year by the Yorkshire Engine Company, Ltd., was the conversion of a locomotive of the Ravenglass and Eskdale Railway to Mr. Poultney's articulated design. We may remind our readers that the gauge of the railway is only 15in. and the use of such a small engine for experimental purposes raises interesting reflections. Is it possible that engines of radically new design could be satisfactorily tested on such a small scale, and, if so, would it not be more economical than building standard-gauge engines ? No doubt the scale effect would interfere in some cases, but in others the size of the model might be sufficient to make it negligible.

The Poultney locomotive is illustrated by Fig. 10, from which it will be seen that a second engine has been added under the tender. This engine has smaller cylinders than the original engine, the cylinders of which have been slightly increased in diameter, the existing cylinder ratio being now 70 to 30. The driving wheels, coupling rods, &c., are the same in both engines. The old boiler is retained and it makes enough steam for the two engines, because the maximum point of cut-off in all cylinders is fixed at 50 per cent. instead of the more usual maximum of 75 per cent. to 85 per cent. The difficulty of starting with a short cut-off is overcome by the provision of starting ports in the piston valve heads. These ports supply sufficient steam to start the engine, but have little or no effect at running speeds, when the quantity of steam they can pass is negligible. We are told that extended trials of this little engine have shown an increase of tractive power, with the same boiler, of over 30 per cent., and the engine now hauls loads of 50 tons as against the 30 tons before conversion.

Other Manufacturers.

A large number of engines of various standard designs were built by Sir W. G. Armstrong, Whitworth and Co., Ltd., during the year. Included in the work were a score of 2–6–0 tender locomotives for Egypt, thirty 4–8–0 engines and tenders for the Buenos Aires Great Southern, ten tank engines for the Leopoldine Railway, with 16in. by 22in. cylinders, and fifty 0–6–2 engines for the Great Western Railway. John Fowler and Co., (Leeds), Ltd., besides building their familiar steam locomotives for plantation and estate work, continued to develop their design of oil-motor locomotives, two of the engines which it turned out being arranged so that the gauge may be reduced from 2ft. 2½in. gauge to 2ft. William Beardmore and Co., Ltd., Dalmuir, completed an order from the L.M. and S. Railway for sixty-five goods tank engines, and made many sets of Beardmore-Caprotti valve gear, and began work on the mechanical parts for two double bogie 0–4–4–0 internal combustion electric locomotives to the order of the General Electric Company, Ltd. The internal combustion engine has six 8¼in. by 12in. cylinders, and will develop 350 H.P. It is being made at Parkhead. The locomotives are for the North-Western Railway of India. Robert Hudson, Ltd., of Leeds, report continued progress with its 20 H.P. paraffin rail tractor.

A Large Oil-Electric Locomotive.

Towards the end of the year the Canadian National Railways placed in operation the first unit of the 2660 H.P. oil-electric locomotive, the construction of which has excited so much interest for months past. The complete locomotive is illustrated in one of our Supplements to-day. It consists, as will be seen, of two similar units, each having its own oil engine and electric generator driving four traction motors. It is estimated that the complete engine will have a starting tractive effort of 100,000 lb., and a continuous tractive effort of 42,000 lb. Each unit contains a Beardmore twelve-cylinder oil engine of the solid injection type. The cylinders are 12in. by 12in., and the nominal rating is 1330 H.P. at 800 r.p.m., but the engine may be run down to as low as 300 r.p.m. The full horse-power consumption is given as 0·43 lb. per hour. The silencer of this engine is a Clarkson thimble boiler which can be used either dry or as an economiser when there is a demand for steam for train heating, supplying hot water to another Clarkson thimble boiler, oil fired. The electrical plant was designed by the Westinghouse Electric and Manufacturing Company, of Pittsburg, and made by the Canadian Westinghouse Company, of Hamilton, Ontario. A lead storage battery of 21,340 ampere-hour capacity is employed for starting. The Canadian Locomotive Company was responsible for erection and assembly of the locomotive as well as the supply of certain parts.

Each unit carries 8000 lb. of fuel oil, 11,000 lb. of water for the boiler, 3000 lb. of cooling water, 3000 lb. of sand, and 1000 lb. of engine lubricating oil. The weight of the complete engine is approximately 290 long tons, of which nearly 215 tons are on the drivers. On November 24th a test run was made of one unit on the 220 miles between Belleville and Montreal with 920 tons behind the engine. A speed of 64 m.p.h. was attained, and we are informed that the engine ran with a clean exhaust, that there was no torsional vibration, and that the governor acted perfectly.

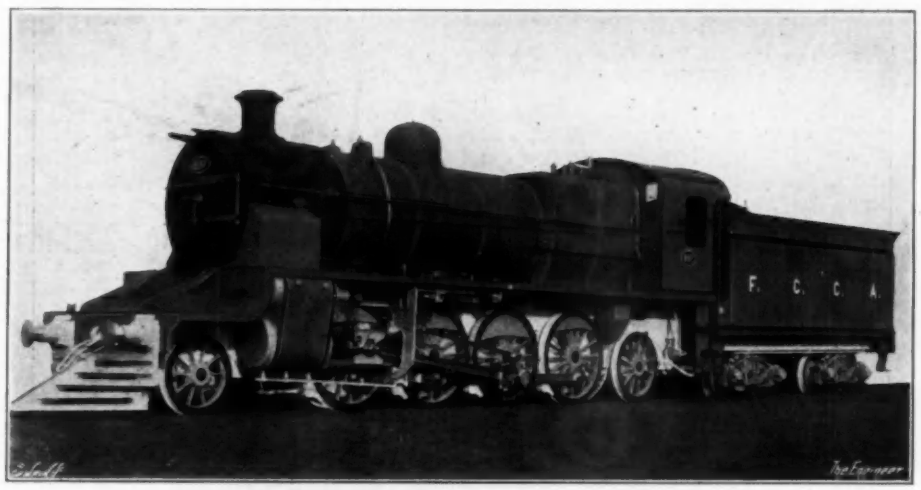


FIG. 15—5FT. 6IN. GAUGE ENGINE FOR SOUTH AMERICA—STEPHENSON

Water Supply in 1928.

No. I.

A LARGE amount of water supply works is in course of being carried out all over the country, and a larger amount still is being prepared for or is in contemplation. Reference is made below in separate paragraphs to outstanding works, and, in addition, the following towns have in hand, or under consideration, schemes of greater or less importance :—Alton ; Ashby-de-la-Zouch ; Axbridge (£43,300) ; Ayr (£250,000) ; Bath ; Birkenhead ; Blackwell (£140,000) in conjunction with Warsop and Skegsby ; Burnham-on-Sea (Somerset) ; Chard ; Chelmsford ; Darlington (£150,000) ; Evesham ; Goole (£52,000) ; Halifax ; (£86,330) ; Kingsbridge in conjunction with Salcombe and Dartmouth (£63,000) ; Llanelly (£160,000) ; Margate ; Minehead ; Neath ; Paignton ; Pembroke ; Saunton-Sands ; Southport (£85,000) ; Street ; West Dean and Coleford (£61,000) ; Wigton, &c. In some cases we have added in brackets the estimated cost—in round figures—of the undertakings involved.

In the early part of the year the Bill deposited by the Colne Valley Water Company (Herts.), in which powers were sought to sink two additional wells and to carry out other works, met with heavy opposition from the Metropolitan Water Board, and was withdrawn. The company agreed to take water in bulk from the Board. With regard to Wigton, the Council in the middle of December decided to proceed with the laying of 65 miles of water mains, of diameters of 7in., 5in., 4in., 3in., and 2in., and the construction of two service reservoirs, one balancing tank, and two intakes at the springs on Townthwaite Fell. This scheme will afford a supply to eleven parishes. The sanction of the Ministry of Health has been obtained. Doncaster completed the second pumping station at Nutwell. The erection of the pump, motor and electrical equipment was concluded, and the plant put into commission in conjunction with the first pumping station.

Quite a feature of the year was the number of boreholes put down. For waterworks purposes they were sunk, among others, by the Bolton Corporation, the Chard Rural District Council, the Doncaster and Tickhill Joint Water Board, the Gravesend Corporation, the Limpsfield and Oxted Waterworks Company, the Maidstone Water Company, the Scarborough Corporation, the South Staffordshire Water Company, the Thorne and District Water Company, and the Tunbridge Wells Corporation. The London Underground Railways put down five and the London and North-Eastern Railway three. Manufacturing and business firms which sank them included general stores, several artificial silk manufacturers, paper makers, sugar manufacturers, oil refineries, photographic material manufacturers, gramophone manufacturers, cement works, &c. &c.

Metropolitan Water Board.

Works in Connection with the Supply from Queen Mary Reservoir at Littleton.—The erection of the two vertical triple-expansion engines with single-acting plunger pumps by Worthington-Simpson, Ltd., together with the installation of the boilers by Babcock and Wilcox, Ltd., in the new pumping station at Kempton Park were completed during the year. The construction of the twenty-four open rapid gravity primary filters at Kempton Park was in progress during the past twelve months, and it is hoped that these will be completed early next summer. Particulars of the pumping installation and of the primary filters were given in our Annual Article on "Water Supply" for the year 1926. The contractors carrying out the construction of the filters are William Moss and Son, Ltd., who also obtained the contract for the laying of mains to supply raw water to the above primary filters, for conducting the primary water to the secondary filters and the increased discharge of the secondary filters to the pumps, also for various delivery mains from the new pumps to the existing pumping mains. This work was in progress during the past year and it is hoped will be completed early this year.

Works for the Improvement of the Supply North of the Thames.—Work was commenced in January last for the construction of a concrete covered service reservoir of a capacity of just over 20,000,000 gallons at Bishop's Wood in the parish of Hornsey. The walls and floor of the reservoir are constructed in mass concrete and the roof in reinforced concrete supported on the mass concrete walls and reinforced concrete columns. There are 85,000 cubic yards of earth to excavate, 60,000 of which have been taken out. The depth of water is to be 20ft. The work is being carried out by Messrs. Stewart and Partners, of Baker-street, London. Towards the end of 1927 Messrs. William Press and Sons obtained a contract for the laying of a 48in. main from the works at Cricklewood to this reservoir, continuing beyond it as a 42in. main to the existing reservoir at Fortis Green. The whole of the main laying was carried out during the year and the contract completed with the exception of one or two small incidental works. This is an extension of the Kempton to Cricklewood main. Early in the year, Howard Farrow, Ltd., began the laying of a 24in. main from the pumping station at Fortis Green to Southgate Reservoir and that work was practically completed. During the year, too, a 20in. main was laid along the new Cambridge arterial road from Enfield to Brookfield-lane, Cheshunt, and a main 14in. in diameter, reducing for a portion of its length to 12in. diameter, along this lane for the improvement of the supply to the urban district of Cheshunt which now forms part of the Board's area of supply. The work was carried out by Whittaker Ellis, Ltd. Contracts were entered into with Davey, Paxman and Co., Ltd., for the suppiy of an oil engine-driven centrifugal pump at Hoe-lane Pumping Station to pump 1,000,000 gallons per day into these mains under a pressure due to Holtwhites Reservoir at Enfield—T.W.L. 225ft. O.D.—and for the supply of two oil engine-driven centrifugal pumps at Cheshunt Pumping Station, each capable of boosting 500,000 gallons per day from the pressure due to Holtwhites Reservoir to Darnicle Hill Reservoir at Goffs Oak—T.W.L. 367ft. O.D.—for the supply to the higher portions of Cheshunt. It is intended early this year to lay a main 20in. in diameter from the pumping station at Haggar-

lane, Woodford, to Buckhurst Hill Reservoir, to improve the supply to the north-eastern portion of the Northern District.

It is proposed to replace the old and uneconomical engines at Haggar-lane Pumping Station with oil engine-driven reciprocating pumps of increased capacity. Tenders have been invited for this machinery. A contract will shortly be entered into for the laying of 24in. and 18in. mains in connection with the improvement of the supply to Hendon.

Works for the Improvement of the Supply in the Board's Kent District.—As stated in our last Annual Article, it has been decided to remodel the Deptford pumping Station, and a contract for the supply of the engines and pumps was entered into during the year with Hathorn, Davey and Co., Ltd. A start was made on the sinking of a well 14ft. in diameter which is to be used for collecting water from the three existing wells at this station, to which it will be connected by adits. It is to be lined to the top of the hard chalk with cast iron rings, each ring comprising six segments. The sinking of the well reached a depth of approximately 70ft. by the end of the year. Tenders are now being invited for the construction of a new pumping station.

Batley.

During the year work on the construction of the new Reservoir at Brownhill for the Corporation of Batley progressed most favourably. The average level of the embankment is now 6ft. below top bank level, and with the exception of a few minor details associated with the work, the new reservoir, taken as a whole, may be said to be almost completed. The work of the laying of the 18in. aqueduct, which will link the new reservoir with the town, and which will be some 17 miles in length, was with the exception of the steel bridge spanning the River Calder at Cooper Bridge, almost completed.

Birmingham.

Progress with the construction of the Bartley Reservoir was delayed by a slip which took place in the outer slopes of the main embankment, and necessitated the construction of new retaining walls and an addition to the earthwork of the dam. In the bed of the reservoir about 94 per cent. of the area was covered with either concrete or beaching, and it is hoped that the work will be practically completed within the next few months.

Work in connection with the laying of 60in. diameter concrete-lined steel pipes forming the Third Main on the Elan Aqueduct, was continued throughout the year on three of the longer syphons—the Downton, Teme and Severn Syphons—and the total length of main laid up till the end of the year amounted to about 8¾ miles.

Bradford.

Scar House Dam forms the principal portion of certain Works which were authorised by Act of Parliament in 1913 and 1925, whereby powers were granted the Corporation of Bradford to construct a storage reservoir of 2200 million gallons capacity on the upper reaches of the river Nidd, immediately below Angram Reservoir. The construction of the dam was begun in 1921 and work has proceeded uninterruptedly since that date. It is being built of concrete and displacers, lined with heavy masonry face work on the downstream side and also on the upstream side where exposed. For the full length of the dam a "cut-off" trench was excavated to a depth of 60ft. below the river bed through strata of alternate shale and limestone beds. At the extreme south end the ground rises to a height of about 205ft. above the river, making the depth of the trench at that point well over 260ft. The depth of water to be impounded is 154ft. 6in. above the river bed. The total length of the dam is over 600 yards, with a width at bottom of 140ft. and at the top of 11ft. Preliminary work and excavation occupied about three years, and actual constructional work has been in progress for over four years.

During the past year about 130,000 cubic yards of concrete and masonry were added to the structure, bringing the total volume of completed work up to 430,000 cubic yards out of an estimated gross total of 540,000 cubic yards. The height is now 104ft. 6in. above the river, leaving 50ft. to be completed to the overflow sills, above which a roadway will be constructed on ten arches of 30ft. span, with the necessary approaches.

Cardiff.

Taff Fawr Pipe Line.—The laying of the 24in., 27in., and 30in. main of steel concrete-lined pipes was so far completed during 1927 that it was brought into use. During 1928 subsidiary works, including new outlet pipes from the Cantref Reservoir, connecting lengths of 30in. bitumen-lined steel and concrete mains, Venturi meters, &c., were carried out, and it is expected that the whole of the works will be complete by March, next.

Wenallt Reservoir.—The construction of the northern half of the Wenallt storage reservoir was completed during the year, the difficulties of the site having been overcome, and the reservoir is now in commission.

(To be continued.)

Steamships and Steam Marine Engineering in 1928.

No. I.

A WELCOME revival in shipbuilding was enjoyed in all the important centres of the industry throughout the year. The increased output was greatly influenced by the larger number of motor vessels constructed. Particulars of these ships are given elsewhere in to-day's issue.

There was a marked absence of labour troubles in the industry, and the cordial relations between the Federation of Shipbuilding Employers and the various trade unions connected with shipyard work continued. Towards the end of the year a modified form of procedure was presented by the Society of Boilermakers to its members which, it is hoped, will enable that body of workers to participate with the other unions in the prevention of disputes, by the local settlement of difficulties as they arise. The increased output was undoubtedly due in large measure to the now very efficient state of our principal shipbuilding and repairing yards.

It may be of interest to quote a few of the larger outputs. Harland and Wolff, Ltd., launched at all their establishments a total of 101,786 gross tons with a total machinery output of 119,000 I.H.P., both figures being larger than were last year's returns. On the Clyde the year was the best since 1920, over 229 vessels being launched, representing a total of 601,918 gross tons and a machinery output of 705,762 I.H.P. The largest output on the river was that of Lithgows, Ltd., with fifteen vessels aggregating over 80,000 tons, while John Brown's yard came second with four liners totalling over 78,000 tons.

There was a notable advance in the tonnage launched on the Tyne, Wear and Tees, and the combined establishments of Swan, Hunter and Wigham Richardson, Ltd., including Barclay, Curle and Co., Ltd., at Glasgow, were responsible for 154,342 tons and 106,430 I.H.P. of machinery. Of these totals 120,910 tons and 73,080 I.H.P. of machinery were launched on the Tyne and Wear. At Birkenhead, Cammell Laird and Co., Ltd., launched the largest tonnage so far dealt with by the company in any one year, namely 78,161 gross tons and 45,150 I.H.P. of machinery.

Most yards began the New Year with a fair share of orders, but if the increased output is to be maintained a constant flow of new orders will be needed. There are many who regard further measures of grouping or rationalisation along the lines recently followed in the steel industry as a necessity if the industry is to be put upon a sound basis. In spite of the activity in building, competition was keen throughout the year and prices were in most cases unfavourable to profit earning.

In what follows we touch upon some of the main technical advances of the year. They included the utilisation of higher steam temperatures and pressures with consequent advances in boiler, turbine, condenser and auxiliary machinery design. A greater interest was shown in the combined reciprocating engine and exhaust turbine for medium-sized ships, and some work was done on new types of steam engines for marine propulsion. The work done on pulverised fuel by British shipowners and marine engineers definitely moved the centre of interest in this development from America to Great Britain. The extended use of pulverised coal at sea should in the near future prove a real help to our stricken coal industry. The adoption of electric propulsion for the new P. and O. liner "Viceroy of India" introduced a new and important factor which will influence the future of marine engineering. In to-day's Supplement we give a view of the Panama-Pacific turbo-electric liner "California," which will be referred to in a second article, along with the "Viceroy of India."

Some Notable Passenger Liners and Steamships.

In April last the 20,000-ton geared turbine liner "Orford" was added to the fleet of the Orient Line. She is the fourth ship of her type, and a fifth, the "Orontes," is now in an advanced state of construction at Vickers-Armstrong's Barrow Yard. In general, the design of the "Orford" follows that of the earlier ships, the "Orama," "Oronsay" and "Otranto," but improvements have been made in the form of the hull and the machinery equipment. The "Orford," a view of which is reproduced in Fig. 1, has a length of 658ft. with a beam of 75ft. and a depth of 47ft. She is a two-class liner and one of her outstanding features is a very spacious boat deck with an area of over 16,500 square feet. The propelling machinery consists of twin-screw single-reduction geared turbines. There are three Parsons turbines driving each main gear wheel and the total output is 20,000 S.H.P. at a propeller speed of 95 revolutions per minute. Steam is generated in six 16ft. 6in. diameter double-ended boilers and two single-ended return-tube boilers, all of which are oil fired under forced draught. The saturated steam pressure is 215 lb. per square inch at the turbine stop valves. Both the engine-room and deck auxiliaries are largely electrically operated, current being supplied by four Allen turbo-generator sets. On her full-power steaming trials with a speed of 19 knots the fuel consumption for all purposes was 0·785 lb. of oil per S.H.P. hour. The service performance of the "Orford" and her three sister ships fully confirmed the good opinions formed by her owners on the trial runs. The Orient Line service to Australia is made at a series of different speeds over various parts of the route, and full-speed results are not therefore available. We understand, however, that the performance of the "Orford" at about two-thirds full power showed a fuel consumption of about 0·80 lb. of oil for propulsion and 0·86 lb. for all purposes, which is an excellent figure considering the large auxiliary load which remains constant as the shaft horse-power is reduced.

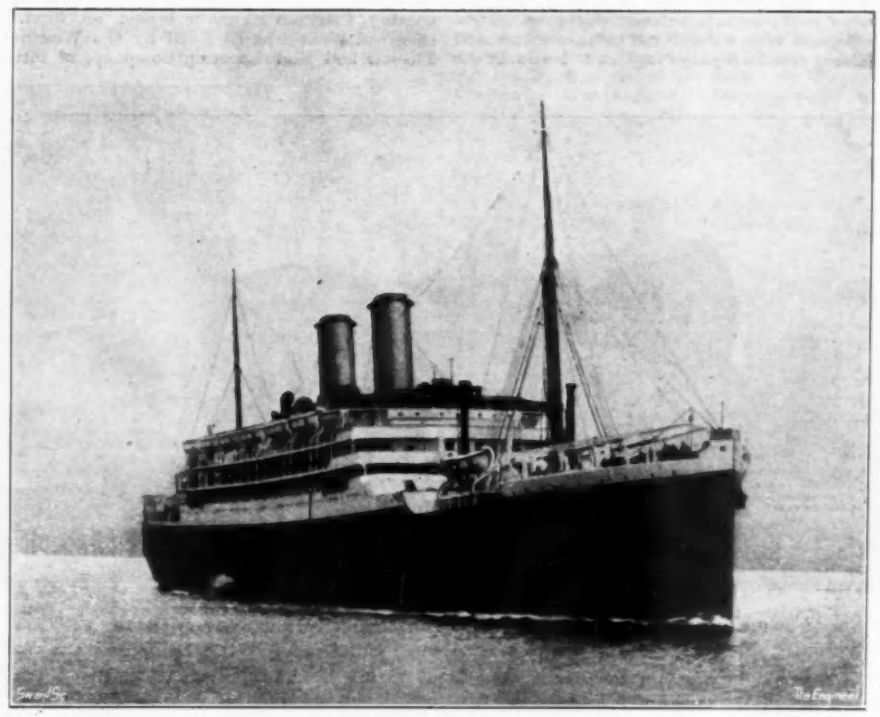


FIG. 1—THE ORIENT LINER "ORFORD"

The most important shipbuilding programme executed in this country during the period under review was the further delivery of liners, cargo ships and coastal vessels for the Canadian Pacific Railway Company's Altantic and Pacific Ocean services. The technical advance made by Mr. John Johnson, the company's chief superintendent engineer, in the adoption of high-pressure water-tube boilers working in conjunction with Scotch auxiliary boilers giving a definite segregation of the main feed from the doubtful feed of the auxiliaries, has placed Great Britain in the forefront with regard to the economical propulsion of large steamships. In his contribution to the discussion on Lord Weir's and Mr. Harold Yarrow's note on "The Generation and Utilisation of High-

pressure Superheated Steam for Marine Propulsion," presented at the Institution of Civil Engineers' Centenary Conference—see THE ENGINEER of June 8th—Mr. Johnson stated that by employing high-pressure superheated steam in modern turbines with up-to-date auxiliaries he was able to reduce the total operating costs of passenger liners by 20 to 30 per cent. and those for cargo ships by 15 to 20 per cent. The excellent results obtained in the "Empress of Australia" with 220 lb. pressure and 600 deg. total steam temperature, which gave a fuel consumption of 0·69 lb. per S.H.P. hour for propulsion and 0·74 lb. for all purposes, were improved upon in the "Duchess of Bedford"—see to-day's Supplement. The figures for this liner and her sister ship were 0·60 lb. and 0·64 lb. of oil respectively, indicating a saving of 13 per cent.

In the new 40,000-ton quadruple-screw liner the "Empress of Britain," which was ordered from John Brown and Co., Ltd., in November last, the turbines will work at about 375 lb. steam pressure with a maximum boiler pressure of 425 lb., and the total steam temperature will be about 700 deg. Fah. In this ship nine water-tube boilers designed by Yarrow and Co., Ltd., and constructed by John Brown and Co., Ltd., are to be installed.

At the Govan Yard of the Fairfield Shipbuilding and Engineering Company, Ltd., work was begun on a new 25,000-ton C.P.R. liner, the "Empress of Japan." This ship will be propelled by twin-screw high-pressure geared turbines of the type employed for the "Duchess" class liners and will have a designed speed of about 21 knots.

The first C.P.R. vessel to be delivered in 1928 was the coastal steamer "Princess Elaine," illustrated in to-day's Supplement. She was built and engined by John Brown and Co., Ltd., at Clydebank, and is a 290ft. triple-screw geared turbine ship of about 2000 gross tons. Her machinery is designed to give a service speed of 18 knots, and on the trial run 19·8 knots was attained. With her three funnels and two masts the ship presents a very handsome appearance. She will be employed in the passenger and motor car ferry service between the Vancouver mainland and Nanaimo on the island of Vancouver.

At the beginning of June the 21,500-ton twin-screw liner the "Duchess of Bedford," the first vessel of her type, sailed from Liverpool to Montreal. She also is illustrated in to-day's Supplement. In THE ENGINEER of June 1st we gave a full account of this interesting liner, and by permission of Mr. Johnson we were able to include in our illustrations a diagrammatic machinery arrangement showing the feed and steam connections. The main Yarrow type oil-fired water-tube boilers, of which there are six, work at a pressure of 370 lb. per square inch with 250 deg. of superheat. Two 200 lb. pressure Scotch boilers are used to supply steam to the auxiliary machinery and to by-pass a certain amount of steam to the main turbines so that the condensate is augmented and the necessary make up for the feed assured. In all the "Duchess" vessels the Weir regenerative type of condenser is installed. This improved type of condenser was fitted into a large number of ships, while in six steamers built on the Tyne Mirrlees-Delas-Ginabat condensers were installed. Both turbo-electric and oil-electric generator sets are utilised in the "Duchess" liners. The service results of the "Duchess of Bedford" are very satisfactory and they fully bear out the expectations deduced from the trial performance.

Shortly after the "Duchess of Bedford" was placed in commission, William Beardmore and Co., Ltd., completed at Dalmuir the sister liner, the "Duchess of Atholl." A view of this ship is given in Fig. 2. In our issue of July 13th we described a voyage made in this fine Atlantic liner from Liverpool to the Outer Hebrides. On the measured mile trials, which were made at Skelmorlie early in June, fuel consumptions of 0·64 lb. of oil for all purposes and 0·60 lb. for propulsion only were obtained, which fully bore out the figures given by Mr. Johnson at the Institution of Civil Engineers' Centenary Conference. The fourth "Duchess" liner, the "Duchess of York," was launched at John Brown's yard on September 20th, by H.R.H. the Duchess of York herself. This ship is to be ready for service in March next. Meanwhile, the third liner, the "Duchess of Richmond," which was launched on June 18th at John Brown's Clydebank yard, was completed and ran her trials towards the end of the year.

Another small C.P.R. passenger vessel built on the Clyde was the "Princess Norah," a single-screw, 250ft., coastal steamer, with a speed of 16½ knots on trial. She was built and engined by the Fairfield Shipbuilding and Engineering Company, Ltd., at Govan, and left Glasgow at the end of November for Vancouver. She is propelled by triple-expansion steam engines working in conjunction with Scotch boilers. Work was begun at the Fairfield engine shops on the new machinery equipment for the C.P.R. liner "Empress of Canada," which was built at Fairfields in 1922, and equipped with 21,000 S.H.P. double-reduction geared turbines, giving her a speed of over 20 knots. In order to give her a similar speed to that of the new liner the "Empress of Japan," now under construction at the Fairfield yards, a new set of Parsons type single-reduction geared turbines with Weir regenerative condensers is to be installed and new oil-electric generator sets, supplementing the existing turbo-generator sets, will also be fitted. The boilers will be fitted with smoke-tube superheaters, and stage feed heating will be installed. The machinery is designed to give an output of 26,000 S.H.P. at 120 r.p.m. in continuous service, with a maximum overload rating of 29,000 S.H.P., if required. New propellers of the solid type are to be fitted to the ship. Mr. J. Johnson is to give a paper at the Spring Meetings of the Institution of Naval Architects, in which the service performance of these interesting ships will be discussed.

Another notable building programme was that of the Canadian National Railways, which placed with Cammell Laird and Co., Ltd., at Birkenhead, an order for five passenger and cargo ships for the services of the Canadian National (West Indies) Steamships, Ltd., between Canada and the British West Indies. The design was prepared by A. T. Wall and Co., of Liverpool, which firm also supervised the building of the ships.

We give in to-day's Supplement a view of the first ship, the "Lady Nelson," which was delivered in October. She has a length of 438ft. overall with a breadth moulded of 60ft., and a depth moulded of 32ft. 9in. Her measurement is about 7800 gross tons and she has a designed speed of 15 knots. The propelling machinery comprises twin-screw single-reduction geared turbines of the Parsons type, and there are four single-ended Scotch boilers, which are oil-fired under forced draught and supply superheated steam at 220 lb. per square inch. The passenger accommodation is of a very high order and occupies three decks of the ship. Provision is made for the carrying of refrigerated and ordinary cargo. The sister ship to the "Lady Nelson," the "Lady Hawkins," sailed for Canada at the end of November, and the three other steamers—the "Lady Drake," "Lady Somers," and "Lady Rodney"—were all launched before the end of the year. The two ships last named differ slightly from the other three in form and equipment, and they will be employed in the banana-carrying trade between Jamaica and Canada.

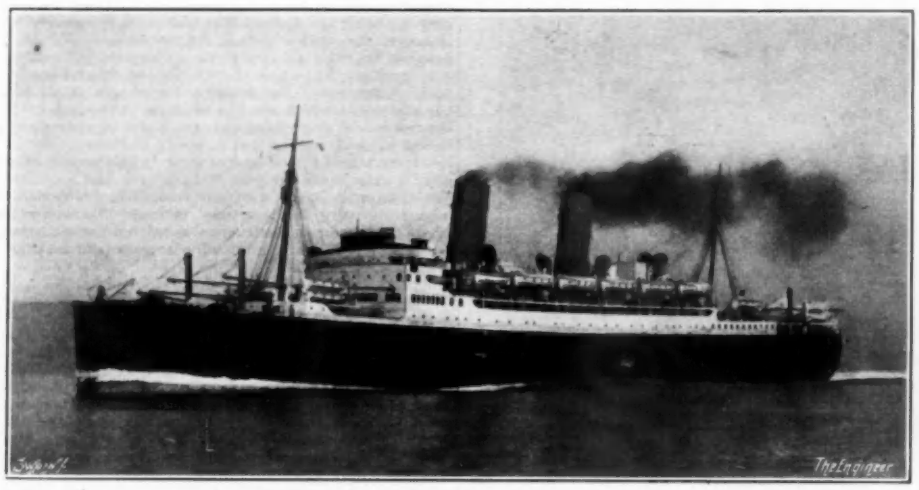


FIG. 2—THE C.P.R. LINER "DUCHESS OF ATHOLL"

Some Fast Cargo Steamers.

Some unusually fast and efficient cargo-carrying steamers were completed during the year, and the competition of high-powered motor vessels seemed only to stimulate still further the construction of such steamers. Outstanding in this respect was a fleet of five 14-knot cargo vessels for the Atlantic service of the Canadian Pacific Railway Company. The first ship to enter that service was the Denny-built "Beaverburn," a full description of which will be found in the issue of THE ENGINEER for January 12th last year. Two Barclay-Curle-built steamers, "Beaverford" and "Beaverhill," followed shortly afterwards, and were succeeded by the "Beaverbrae" and "Beaverdale," constructed by Armstrong, Whitworth and Co., Ltd. All these ships are vessels of 10,000 tons gross, with a length of 512ft. and a beam of 61ft. 6in., and they are propelled by 7350 S.H.P. twin-screw single-reduction geared turbines of the Parsons type, which are supplied with superheated steam at 250 lb. pressure and a temperature of 650 deg. Fah. total. In three of the ships Yarrow-type water-tube boilers, working in conjunction with Scotch auxiliary boilers and equipped with Erith-Roe mechanical stokers are fitted. In the other two ships, the "Beaverhill" and "Beaverbrae," the same arrangement of main and auxiliary boilers holds, but the water-tube boilers are of the Babcock and Wilcox coal-burning type, fired by hand.

During the trials of these ships it was shown that the guaranteed consumption of 1·1 lb. of coal per S.H.P. hour was improved upon, and in actual service results it is expected that there will be no difficulty in maintaining a consumption of about 1 lb. of coal per S.H.P. hour, using ordinary bunker coals. We understand that the mechanical stokers have given very satisfactory results.

Some fast cargo ships were built for the Calcutta service of the Hain Steamship Company, Ltd., by Barclay, Curle and Co., and Harland and Wolff, Ltd. They included the "Bangalore" and "Burdwan" and the "Behar" and "Bhutan," the last vessel being launched in December. They are 6000-ton single-screw vessels, and are propelled by balanced quadruple expansion engines, supplied with 230 lb pressure steam, the designed speed being 14 knots. The voyages of the completed ships show them to be extremely satisfactory as regards fuel economy and general running.

Sir John Ellerman ordered, it will be remembered, three similar cargo ships propelled by high-pressure reciprocating steam engines, modern geared turbine machinery, and Doxford opposed-piston oil engines respectively. In the "City of Roubaix," which was built by Swan, Hunter and Wigham-Richardson, Ltd., and engined by the Wallsend Slipway and Engineering Company, Ltd., with the latest type of high-pressure geared turbines, a boiler pressure of 300 lb. per square inch, with 175 deg. Fah. superheat, is employed. This ship was commissioned early in 1928, and her machinery was favourably commented upon, both with regard to its smooth and its efficient running. Her performance will be compared with that of the "City of Canberra," propelled by high-pressure quadruple expansion engines, and by the Barclay, Curle built and engined motor vessel, the "City of Lille."

In regard to steam turbine development in general it is of interest to learn that the Parsons Marine Steam Turbine Company, Ltd., constructed during 1928 geared turbines representing a total of 155,600 S.H.P., with extra gearing equivalent to 138,000 S.H.P., while 82,500 S.H.P. of gearing was cut by the firm for its various licencees.

Oil Tankers and Special Steamers.

Steam-engine propelled oil tankers for British and foreign owners formed an important item in the output of the Clyde and Tyne yards. A vessel of unusual interest is the rolling stock transport steamer "Seatrain," which was built by Swan, Hunter and Wigham-Richardson, Ltd., for service between New Orleans and Havana. A full account of this ship will be found in THE ENGINEER for November 30th. The Furness Shipbuilding Company, Ltd., which had one of the largest outputs of the year on the North-East Coast, finished the "Coalhaven," a self-discharging collier. In general, the design follows that of the "Coalfax," to which reference was made in last year's annual article, and the coal unloading equipment was supplied by the Fraser and Chalmers Engineering Works, of Erith, Kent, in conjunction with their associated firm the Robins Belt Conveyor Company, of New York.

Some Cross-Channel Steamers.

The year just ended saw the commissioning of the three new geared turbine steamers which were built by William Denny and Brothers, Ltd., at Dumbarton, for the Irish Channel services of the London, Midland and Scottish Railway Company, between Heysham and Belfast. They are 360ft. ships, with a beam of 53ft. and a depth of 19ft. 6in., with a gross tonnage of close upon 3600. The first ship, the "Duke of Lancaster," was launched in November, 1927, and ran her official trials in the spring of 1928, and the second vessel, the "Duke of Argyll," followed. On the occasion of the launch of the third ship, the "Duke of Rothesay," Mr. Maurice Denny announced that that vessel was the one hundredth steam turbine-driven ship built by his firm. Each of these steamers has a designed speed of 21 knots, and is propelled by a twin-screw arrangement of Parsons type geared turbines. Steam is supplied by six 225 lb. pressure water-tube boilers of the Babcock and Wilcox type, which are hand-fired with coal and work under forced

draught on the closed stokehold system. Later in the year the same builders launched and completed the English Channel steamer "Worthing" for the Southern Railway Company. This steamer has a length of 306ft. with a beam of 38ft. 6in., and a depth of 15ft. 9in., and measures about 2288 gross tons. The general arrangement of the turbines and boilers is similar to that of the Irish Channel ships, but the boilers are oil fired. The same applies to the sister vessel, the "Canterbury," which was launched towards the end of the year. She is larger than the "Worthing," and has a length of 329ft., with a beam of 47ft. and a depth of 17·9ft. Her gross tonnage is round about 3114 tons. At the yard of D. and W. Henderson, Ltd., there was launched and completed the 680 gross ton cargo steamer "Deal" for the Cross-Channel service of the Southern Railway Company. She is propelled by 2500 I.H.P. reciprocating steam engines.

Combined Reciprocating Engines and Exhaust Steam Turbines.

The effective combination of reciprocating steam machinery with an exhaust steam turbine, on a single shaft, received considerable attention during the year and several ships were put into commission with this type of machinery. In Fig. 3 we show the Booth Steamship Company's cargo vessel "Boniface," which is the first British ship to be fitted with an exhaust steam turbine working on the Bauer-Wach exhaust turbine system. She is a sister ship to the "Basil," and was delivered to the same owners by R. and W. Hawthorn, Leslie and Co., Ltd., early in 1928. The main engines of the "Boniface" comprise a single set of triple-expansion engines with cylinders of 25½in., 43½in. and 73in. bore and a common stroke of 51in. The exhaust turbine is coupled to the engine through single reduction gearing and a flexible oil coupling of the Beardmore-Vulcan type. That part of the machinery was supplied by Swan, Hunter and Wigham Richardson, Ltd., which firm, together with William Beardmore and Co., Ltd., are the British licencees for the Bauer-Wach exhaust turbine system. The machinery of the "Boniface" has a designed output of 2950 I.H.P. at 75 revolutions per minute and in service will give about 2700 I.H.P. Steam is supplied by three single-ended coal-fired boilers designed for a working pressure of 215 lb. with Schmidt type superheaters giving 150 deg. of superheat. Two series of trials were run off the Tyne under similar conditions as regards draught, weather and course, and accurate feed water measurements were made during two six-hour trials. In the first trial the reciprocating engines were run alone and in the second trial the exhaust turbine was also put into operation. The mean indicated horse-power for the first trial was 2963 at 77·8 mean revolutions and that for the second trial 78·3 revolutions, representing an equivalent of 3000 I.H.P. The water consumption for the first trial was 14·22 lb. per I.H.P. per hour and that for the second trial 10·75 lb., representing a saving with the exhaust turbine in operation of 24·5 per cent. In THE ENGINEER of October 5th we gave a full account of the trials carried out by William Beardmore and Co., Ltd., on the reconditioned Anchor liner "Britannia," which was fitted with Bauer-Wach exhaust turbines. The trials with the reciprocating engine alone showed an oil consumption of 1·04 lb. per I.H.P. hour, whereas with the exhaust turbine in operation the consumption at a total output of about 5000 I.H.P. was only 0·832 lb. The superheaters in this ship are of the Sugden uptake type, giving superheats from 80 deg. to 100 deg. Fah., which were installed in a large number of vessels during the year. Messrs. Beardmore have a large number of exhaust turbine installations in hand, and one of them will be fitted in a 14-knot Clan liner which will be built by the Greenock Dockyard Company, Ltd., and engined by Rankin, Blackmore and Co., Ltd. The total output of the machinery will be about 6000 I.H.P. Arrangements were made later in the year whereby R. and H. Green and Silley Weir, Ltd., will fit Bauer-Wach exhaust turbines at their Falmouth Yard, and the P. and O. steamship "Baradine" is now being fitted out. In an exhaust turbine arrangement introduced by the Parsons Steam Turbine Company, Ltd., a mechanical form of spring coupling replaces the oil coupling, and a very neat arrangement of engine and turbine is thereby obtained. Messrs. Brown, Boveri and Co. introduced a modified drive in which the turbine is fitted with reversing arrangements and is automatically reversed with the main engine, a simple form of elastic coupling being interposed between the two drives. In the proposal put forward by the British Thomson-Houston Company, Ltd., the exhaust steam from the main engine is utilised to drive an exhaust turbo-generator and the current so produced is returned to a motor attached to the propeller shaft. This arrangement is said to have certain advantages as regards space and simplicity of lay-out. The oil coupling of the Bauer-Wach system undoubtedly gives excellent results in service, however, and so far the larger number of combined engine and turbine installations fitted are of that pattern.

New Types of Reciprocating Steam Engines.

In his presidential address to the North-East Coast Institution of Engineers and Shipbuilders Mr. Maurice S. Gibb, of the Central Marine Engine Works, West Hartlepool, gave some interesting figures concerning the actual performance of the modern high-pressure four-crank quadruple-expansion engines which have been installed in the "City of Canberra" and her sister ships. He pointed out that with 265 lb. steam pressure, 150 deg. superheat and 320 deg. heated air to the furnaces a coal consumption of 1·23 lb. per I.H.P. hour for all purposes was obtained at a service output of 4500 I.H.P. The corresponding mean pressure referred to the low-pressure cylinder was 42 lb. per square inch, in marked contrast to the 24 lb. and 31 lb. pressure of earlier installations.

In our issue of August 31st we gave a brief summary of the progress made with the Beardmore-Caprotti valve gear fitted to marine engines. This type of valve gear, which has given such good results on locomotives, has now been fitted to two steamships and the results have confirmed the mechanical soundness of the valve gear and its capability of giving a high thermal efficiency. It is now being fitted to a larger engine, and there is no doubt that it will in most cases effect a saving of 10 per cent. in fuel, which is likely to be increased in the larger units. In last year's annual article we described and illustrated the 1700 I.H.P. double-compound Lentz marine engine which was built by John Dickinson and Sons, Ltd., of Sunderland, for the steamer "Holystone," owned by Common Bros., of Newcastle. We are able to state that the results obtained with this particular engine shows the Lentz type of engine to be definitely superior in economy to the ordinary triple-expansion engine. The owners of the "Holystone" have recently placed with Dickinson and Sons, Ltd., an order for a larger Lentz engine, which will be installed in their new 10,000-ton steamer. The manufacture of triple and quadruple-expansion engines formed a large contribution to the year's machinery output, and, to take only two examples, twenty-five sets of engines aggregating 76,110 I.H.P. were built by David Rowan and Co., Ltd., at Glasgow, and twenty-six sets by the North-Eastern Marine Engineering Company, Ltd., at Wallsend, which firm also supplied North-Eastern smoke-tube superheaters for machinery of 157,300 I.H.P.

(To be continued.)

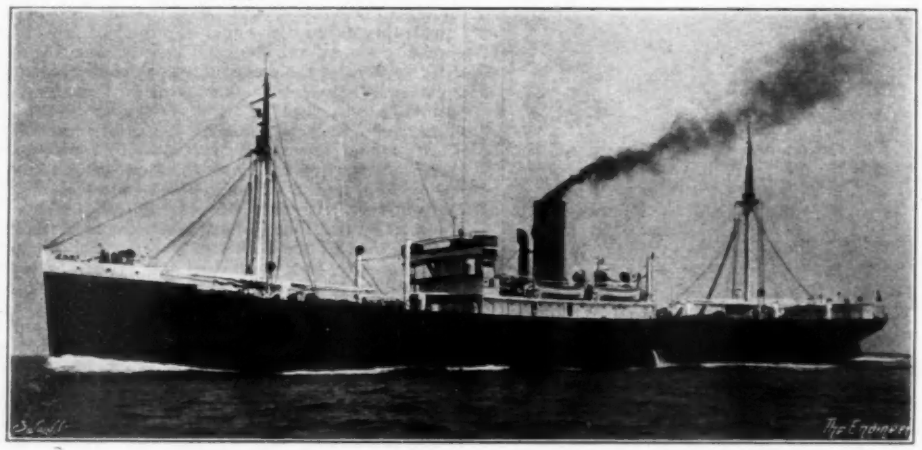


FIG. 3—THE BOOTH LINE CARGO SHIP "BONIFACE"

COOPERS HILL WAR MEMORIAL PRIZE AND MEDAL.—The triennial award of the above-named Prize and Medal, which fell in 1928 to the Institution of Electrical Engineers, has been made by the Council to Mr. W. Phœnix, A.M.I.E.E., for his paper on "Electricity in Agriculture, with special reference to Electro-culture."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Outlook for 1929.

THOUGH there is reasonable hope and prospect of general improvement in the heavy industries of the Midlands and Staffordshire during the year 1929, and the district finds itself as a whole a little better off than a year ago, manufacturers hesitate to pronounce optimistic statements regarding prospects. They admit that the industrial towns of the Midland area have for the most part enjoyed a rather larger measure of prosperity than has been vouchsafed the country as a whole, but though the development has been in the right direction, it has been uneven and slow, and it would be unwise to build high hopes upon it. Birmingham, thanks to the diversity of its industries, has had a happier experience than many of the great industrial centres. Coventry and Wolverhampton have also had a comparatively favourable year owing to their energetic development of what might be called the newer industries, to which they have devoted their attention in recent years. For the bulk of the many industries in South Staffordshire, the year has been one of fairly constant activity, and trading results, in the light of the prevailing situation, may be looked upon as moderately good. One or two industries have experienced a fairly successful time, but in the staple trades such as the chain, anchor, iron and steel industries, the position has been anything but encouraging. However, the improvement in the shipbuilding industry should eventually mean more work in the near future for these Staffordshire trades. Engineers are hopeful of a release of large orders early in the year, and in several of the many branches of engineering practised in this district there are distinct signs of improved business. A steady improvement in the iron and steel industries is expected, partly as the result of the Government's de-rating scheme. This will not be sufficient, however, to bring the district that industrial prosperity which is hoped for, and which is long overdue. While it is possible to take a hopeful view of trade generally, the country has still to face the problem of rehabilitating the basic industries. Fortunately for South Staffordshire the statement which used to be made that when coal and iron were bad, everything else was bad does not now apply to the same degree as was formerly the case. Nevertheless there is still a good deal of truth in this saying. Generally, it may be stated that Midland iron and steelmasters are fairly optimistic of the immediate future, although they expect recovery to be a slow process. There certainly exists amongst manufacturers a belief that the many industries in the Midlands and Staffordshire will make progress during the year 1929.

Engineering Prospects.

There are grounds for confidence in the hope expressed this week by some prominent Midland engineers of better times in the engineering industry in this area during 1929. Definite and permanent improvement they anticipate especially in some branches. The busiest and most favourably placed section of the engineering trade at date is undoubtedly the heavy electrical branch. Makers of power plant have a substantial amount of work in hand. This is mainly in connection with extensions now taking place at home. Overseas contracts are still somewhat scarce, but all the local works are fully employed. The Central Electricity Board is well advanced in the carrying out of its programme, and doubtlessly will be placing considerable business during the year. Prospects for the provision of heavy electrical equipment, such as new generating plant, large sub-stations, large switchgear applications, heavy transformers, heavy industrial applications, and industrial motors, are considered to be very bright, while on the lighter side there are many indications that the use of electricity is extending at a reasonably rapid rate, and with its growth should come an increased market for electrical apparatus for cooking, heating and other domestic purposes. The recent development in the use of electricity in Birmingham is likely to be maintained, especially in the works where the advantages of accurate temperature control are becoming more and more realised. The adoption of electrically-operated pyrometers, distance thermometers, CO_2 recorders, &c., will, it is confidently anticipated, steadily increase. The prospects of electrical engineering are good, therefore, and notwithstanding its powerful equipment, the industry will have to keep on the move to develop at an equal pace with the developing demands upon it. Conditions in the mechanical and constructional branches of engineering are not so rosy. Mechanical engineering has been stimulated in many of its members by the increase of electrification which has helped to make up for an unstable demand from other sources on which the mechanical engineer depends. Builders of locomotives, stationary engines, pumps and associated equipment are not uniformly busy. Though some firms express confidence in the future, others point to the "patchy" nature of business last year, and adopt a "wait and see" view. There does not appear to be any great volume of work in prospect immediately, and although engineers hope to continue to secure sufficient small contracts to keep them going, they are not over sanguine as to the chances of employing during the New Year their full resources. In this area the difficulties of securing a proportionate share of the export trade have not been lessened.

Coventry Engineering.

In Coventry's engineering industries a note of optimism prevails at the opening of the year 1929. The revival in the motor engineering industry during the last quarter of 1928 placed Coventry in an enviable position. Works resumed this week with the cheering assurance generally that orders in hand are sufficient to keep them occupied for some little time to come, while a broadening demand gives promise of continued prosperity. There is a brisk demand for Coventry-made private cars, and commercial vehicle and chassis manufacturers have plenty of work in hand on the passenger side of the industry.

Competition remains very keen, but in this respect the motor industry is not by itself, for whatever business is possible elsewhere, is mostly on a keen competitive basis. The increasing demand for road transport should keep the works busy on the passenger vehicle side, and here the entry of the railway companies into the arena will, without doubt, result in a substantial increase in demand. With the machine tool firms the year has been one of steady progress, the improvement being more marked in the case of export than on home account. The type of machine-tool made in Coventry is not so badly hit by the depression existing in the basic industries, and the opening of the New Year finds the trade in a satisfactory position. Aircraft construction and the manufacture of aero engines rank among the foremost of the city's newer industries, and both branches are, and have been, exceedingly busy. Over 1000 men are employed on the manufacture of steel aircraft at Whitley. Coventry-manufactured aero engines are now being used in over twenty different countries, and the makers, after enjoying a successful year, are looking forward to an exceptionally busy season. Producers of radio apparatus anticipate a good year, and there is an increasing demand for electrical labour-saving devices. Telephone manufacture finds employment for many hands in Coventry, and the past year having been satisfactory, the signs of a more progressive policy on the part of the Government in telephone development give rise to the hope that business may be even better in the coming year.

Machine and Edge Tools.

Midland machine tool makers have had a busy year, and, generally speaking, are at the moment in a strong position. The motor car industry has afforded the largest scope for this industry in the Midlands and Staffordshire. New labour-saving tools have displaced old methods of production in many of the factories, and outlays on the repair of normal wastage have been fairly considerable in the aggregate. Drop forgers, sheet metal workers, and others who supply the motor trade are well employed, and the outlook for all concerned is considered decidedly good. Makers of heavy edge tools are fairly well placed after having experienced an irregular year. Export business has been notably irregular, but a good idea as to future anticipations may be gathered from the fact that the Chillington Tool Works of Wolverhampton are carrying out three separate works' extensions, the most important of which is perhaps the erection of a new building for the forging department.

Rolling Stock.

Midland makers of railway carriages and wagons and other rolling stock commence the year in a fairly good position, although the trade is equipped for dealing with more work than is on the books at present. A fairly large proportion of the business given out by both home and foreign companies recently has come to this area, and with every prospect of a revival of buying by the British railway companies this year the rolling stock industry hereabouts should fare very well. Makers certainly look favourably upon the New Year, and count upon it for some excellent orders. South Africa and South America have been good customers throughout the past year, and have filled in the gaps caused by the lack of demand from home lines.

New Year Orders.

Important rolling stock orders have just been received by Midland firms from the Siamese Royal State Railways. Orders for thirty third-class coaches with steel bodies have been placed with the Midland Railway Carriage and Wagon Company, Birmingham, and for twenty third-class coaches with wooden bodies with the Metropolitan Carriage Wagon and Finance Company, Birmingham. These orders were obtained in the face of foreign competition. The London and North-Eastern Railway has placed a contract for twelve four-cylinder type motor omnibuses, each capable of seating twenty passengers in convertible semi-bucket type seats, with Guy Motors, Ltd., Wolverhampton. The same company has authorised the construction of 110 new locomotives, but nearly the whole of this work will be done in the company's shops in 1929.

Steel Anticipations.

The improvement in shipbuilding, both on the North-East Coast and in Scotland, is regarded as a good omen for the steel trade, the heavy branch of which can well do with a fillip. Midland engineering industries and other steel users contemplate the use of enhanced quantities of finished steel, while steelmasters hope to be able to convert a greater number of engineers to the policy of buying British steel and British steel only. It would appear that the prospects for Midland steel works are brighter than they have been for some time, for producers are getting on better fighting terms with the foreigner than has been the case for years, and the chances are that as the New Year progresses continental production costs will advance and so operate to the further advantage of local steelmasters. That users in this country prefer native material when prices are competitive there can be no doubt, and steelmasters are determined, as they have shown during the past year, to do everything in their power to place those consumers who utilise native material in as good, if not a better position to secure contracts, as those who make use of continental steel. In February last the steelmakers increased their prices by 5s., but made an extra allowance in the amount of the rebate, which had been instituted in the previous September. This rebate was based on the principle of making it worth the while of consumers to use steel produced at home. It covered a wide range of finished materials. Originally rebates of 5s. on sections and plates and 7s. 6d. on joists were offered to consumers who undertook not to buy foreign material. By increasing the difference to 10s. and 12s. 6d., the associated steelmakers left hesitant consumers the choice of accepting the conditions offered or losing contracts in which the use of British steel was specified. In the half-products branch, too, steelmasters are better placed than they were to combat foreign competition, and during the late months of 1928 an increasing number of orders which had previously gone abroad came to the mills at home. This class of business is likely to make headway, and consumers can depend upon it that their wants will be carefully supplied by British steelmasters. An increase in consumptive demand is also likely to arise during the year, for reports from steel-consuming industries are for the most part encouraging, and speak of better business prospects. Midland engineering establishments are hopeful of securing substantial orders, both on home and export account, and of being able to absorb much larger tonnages of steel than they did in the year just ended.

Staffordshire Iron Trade Hopes.

The year 1928 proved disappointing to Staffordshire ironmasters, and though they are prepared for better business in 1929 they are none too optimistic. Last year was marked by several trade spurts, but each movement forward was followed by a relapse, and a real and lasting improvement as the result of the impetus which trade has gained during the past two months is scarcely anticipated. The year has opened quite well for the marked bar mills, which are well placed for orders, but the outlook is less hopeful in the case of makers of Crown and common grade bars. These mills have been doing very little for some months past, and there seems little probability of their being able to secure business in the near future in face of the severe internal and external competition which they have to meet. In the Crown bar branch Lancashire and Derbyshire houses are able to quote several shillings below the Staffordshire price, and the export trade is being captured by makers nearer the coast owing to the heavy transport charges involved in getting the iron from Staffordshire to the port. The nut and bolt trade has fallen off considerably of late years, partly because of continental competition and also owing to the change over to steel as the raw material now adopted by many makers. In the Darlaston nut and bolt trade the position is quiet, and not very encouraging at the moment. There has been a falling off in the general home and export trade, and undercutting is complained of in some quarters. Finished iron prices have not been tested this week, but it is expected that those recently ruling will continue. Marked bars stand at £12, or 10s. below the figure at which they stood a year ago. Crown bars at £9 2s. 6d. to £10 are half a-crown to 5s. cheaper than in January last, while nut and bolt and fencing bars are now offered at £8 12s. 6d. to £8 17s. 6d. against £9 twelve months ago. The brightest department of the iron trade is that dealing with strip for which the tube mills are constantly calling. This material, which cost £11 10s. a year ago, is now procurable at £10 12s. 6d. to £10 15s. It is considered very probable that the use of wrought iron tubes will be greater in the future than in the past year or so, the rust-resisting quality of iron over steel having recently been again commented upon, and some official bodies having stipulated in their contracts for wrought iron tubes.

Pig Iron Position.

Midland blast-furnacemen are still awaiting a return to prosperity for their industry. In January last I stated that they were "nearly discouraged." To-day they are still hanging tenaciously on to hope, though matters appear to be going from bad to worse. At the opening of the year there were 149 blast-furnaces in operation over the Kingdom, out of a nominal total of 437. By the end of November the active furnaces numbered only 135. Some new and improved plants had been brought into service during the year, with a larger productive capacity per furnace than those they displaced, so that the curtailment of output was not so great as a net decrease of fourteen furnaces would suggest. On the other hand, while there were ten blast-furnaces in operation at the beginning of the year in the Staffordshire, Shropshire, Worcestershire and Warwickshire district, and the number has risen to fourteen, there has not been a proportionate increase in output. Moreover, selling prices are lower than they were at the opening of last year by some 5s. per ton. Whereas in January last Derbyshire foundry pig made £3 5s. 6d. and forge £2 19s., they sold on 'Change in Birmingham this week at £2 19s. to £3, and £2 15s. respectively. Northamptonshire brands, which a year ago were £3 and £2 14s., to-day are £2 15s. and £2 11s. 6d. respectively. Such a state of affairs can hardly be called satisfactory, and smelters are frankly discouraged. They fail to see markedly improved prospects for 1929, though they have carefully scanned the horizon for evidences of better consumptive demand which is at the root of the trouble. More healthy conditions were recently anticipated as the result of the Government transport relief, but there have been so many claimants to the rebate that smelters are becoming inclined to the view that it will not very materially assist them to put the industry on an economic footing. The future is fraught with difficulties, and blast-furnacemen in the Midlands do not display much confidence in the opening months of 1929, though they sincerely hope for much better times than were experienced by them last year. One bright feature it is good to note. The cast iron pipe business of Derbyshire, which absorbs a good quantity of pig iron from the furnaces, has shown a steady improvement during the last few months, and the prospects are considered very bright.

Galvanised Sheets.

Midland galvanised sheet mills are in a happier position than they were a year ago, for most of them are fairly well booked, and signs are not wanting of large demands being made upon the industry during 1929, especially by overseas buyers. Export business of late has shown improvement, but the total tonnage sent abroad in 1928 did not reach the level attained in the previous year. It is calculated, however, that British galvanised sheet makers will gradually strengthen their position in the export markets in the world. Most mills have disposed of January's output, and some of February's, and bookings are now being made for March delivery. Values of 24-gauge corrugated sheets are firm at £13 10s., which is fully 7s. 6d. per ton higher than the figure realised this time last year. A revival in buying at home would be very welcome. Light gauge sheets and black sheets are in good request, and a growing demand during the next few months for the latter is expected. There are adequate supplies of raw material, and mills are capable of larger production than they are at present making.

Canal Transport.

The new amalgamation, the Grand Union Canal Company, which from the beginning of the year took over control of the 240 miles of canal which link the Thames with Northampton, Birmingham and Leicester, is evidently determined to modernise and speed-up transport, and to organise inland water traffic on a scale commensurate with present-day transport conditions. It has already, I learn, called in naval architects to conduct experiments regarding the construction of canal boats. Maximum tonnage with minimum draught is aimed at, and it is hoped to do away with the horse-drawn barge and substitute boats driven by internal-combustion engines. Another important innovation is likely to be the introduction of petrol-driven engines to operate the locks. It will now be possible to ship merchandise direct from Bombay to Birmingham. Cargo will be brought from overseas ports to London, discharged into barges at the Limehouse terminus to the Grand Union Canal, and transported without further change to Birmingham.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Good Start.

THREE contracts announced here on New Year's Day may perhaps be accepted as an augury of a coming general industrial improvement. Lancashire constructional engineers were not, on the whole, too well situated during the closing months of the past year, although in the second half of December signs were not wanting of a somewhat brighter outlook. Edward Wood and Co., Ltd., of the Ocean Ironworks, Manchester, has now been awarded a contract for the construction of a new power station at Limehouse for the Metropolitan Borough of Stepney. About 2000 tons of steel work will be used in the construction of the station, and it will be fabricated at the company's works in Manchester. In a different category are the two contracts secured by the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester. One is for the supply to the municipality of Rotterdam of two 42,000-kW turbo-generating sets, and the other for twenty-one electric passenger locomotives for the Great Indian Peninsula Railway Company, the total value of the two contracts being in the neighbourhood of £500,000.

Replacing a Bridge.

The replacement of a 30-ton bridge by one of 150 tons over the Cheshire Lines Railway at Park-road, Stretford, Manchester, is to be carried out by Pearson and Knowles, Ltd., Warrington, next Sunday morning The new bridge has been constructed alongside the embankment, and the work of substitution, which is to be started at 7 a.m., will, it is hoped, be finished before noon, with the lines ready for reopening to traffic.

Industrial Electric Heating.

An exhibition of industrial electric heating, arranged jointly by the British Electrical Development Association, the electricity departments of the Manchester and Salford Corporations, and the Lancashire Electric Power Company, Ltd., is to be held at Belle Vue, Manchester, from Monday to Saturday of next week Among other exhibits of an industrial nature which will be in operation will be a series of electric furnaces, welders, ovens and other appliances.

Personal.

Mr. R. Blackmore, who for twenty-six years has been engineer-in-chief to the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, has resigned his position on his appointment as engineer to the North-West of England and North Wales Electricity Board.

Non-ferrous Metals.

Allowing for the intervention of the holidays, interest in the non-ferrous metals, and especially in the copper section, has shown no sign of falling off. Since the week before Christmas the advance in copper, both refined and standard descriptions, has been particularly marked, and consumers are showing some anxiety to cover themselves forward. The bullish tone of the United States market, coupled with the fact that stocks of the metal in this country show a declining tendency, has had a distinctly strengthening influence on prices here. At the moment of writing the tone is quite firm, and without any apparent indication of immediate reaction, the statistical position favouring copper producers. After a period of easier values, the tin market latterly has witnessed a recovery, although prices on balance are not much above those ruling before the Christmas break. The outlook in this section is, owing to the marked increase in warehouse stocks at the end of December compared with the position disclosed on November 30th, not certain, and renewed bearishness in the near future may be expected. Profit-taking by speculative interests at one time had its effect on spelter, but there has been a recovery since, and quotations remain steady, sales of the metal being on a moderate scale. Lead has registered a further advance on a fair weight of buying interest being shown, and in this section also prices are steady in tone.

Iron and Steel.

Interest in the local iron and steel markets this week has, of course, been more active relatively than in the previous week, although new business continues to move very sluggishly. Apart from odd sales of small parcels of foundry iron, there has been little stirring in this section of the market, and little or nothing in the way of contract bookings has been reported. Although, at the moment, the price outlook, so far as the Midland products are concerned, is not too steady, values are nominally unchanged

in view of the fact that no real test of the market position has taken place. For delivery Manchester or equal distance Derbyshire No. 3 iron is on offer at a maximum of 68s. per ton, with Staffordshire at about 67s. 6d., North-East Coast brands at 79s., and Scottish at from 87s. 6d. to 90s. Finished iron is maintained at £10 per ton for Lancashire Crown bars and £9 10s. for seconds, but the demand at the moment is very slow. Recent contracts placed with constructional engineering firms in this area have provided a welcome improvement in the prospects in this important local channel of consumption, though there are still many firms the order books of which are far from healthy. For the moment, business in steel products, of both home and foreign manufacture, is at a very low level. The former keep very firm in all departments, but in continental steel there has been a further slight easing off in finished materials.

BARROW-IN-FURNESS.

Hematite.

There is nothing fresh to report in the way of new developments in connection with the hematite pig iron trade of this district. It continues to remain steady, with consumers showing an inclination to book forward. This gives the impression that the requirements of buyers are likely to be more steady and represent bigger tonnage than was the case a few months ago. The bulk of the trade is in this country, and not a great deal is being shipped to the Continent, though there are occasional cargoes from Barrow, and one left last week for Antwerp. American trade is spasmodic. What with the improvement in trade, and the fact that the steel departments' requirements are fairly heavy, most of the makes in the district are cleared. There is not much chance of stocks accumulating at the present time. Special qualities are in fair demand. The iron ore trade remains unaltered, and is not likely to improve unless there are more furnaces put in blast in this district, a thing which is not probable at present. Foreign ore is being imported in restricted quantities. The steel works are busy at present; so busy, in fact, that the rail mills worked right through the Christmas holidays, which is most unusual. Orders are held for a few months' work, but fresh work would be welcome. The market is fairly quiet, and competition is keen.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Prospects.

THERE is little to report about actual operations at the steel works this week, as, at the time of writing, the holiday is still more or less general. Some of the open-hearth plants have continued working to meet the demand for soft steel, which continues at a good level and promises to be well maintained. There is thought to be also a better outlook for high qualities of acid material. The plants producing railway axles, tires, and springs will have rather more work with which to resume after the stoppage, as specifications have recently been received from the home companies. These are, however, on only a small scale, and the large orders usually placed in December have not yet been received, so that the prospects of this branch are uncertain. Generally speaking, there is a feeling of optimism with regard to the trade of the new year. In various centres of the country the tide of depression has definitely turned, and the upward movement is considered sure to spread to Sheffield, which is generally late in receiving its share of benefit from any revival. The improvement in shipbuilding and engineering holds out good promise to Sheffield, as it will result in increased calls for steel and tools.

Railway Orders.

Sheffield is interested, both directly and indirectly, in a number of orders for rolling stock for the Siamese State Railways which have just been placed by Prince Purachatra, the Minister of Communications for Siam, who is visiting this country shortly. The local firm of Cravens Railway Carriage and Wagon Company is to build sixteen first-class coaches with wooden bodies. Two companies associated with firms which have their headquarters in Sheffield are to build the remainder of the stock required—the Midland Railway Carriage and Wagon Company, of Birmingham, thirty third-class coaches with steel bodies; and the Metropolitan Carriage, Wagon and Finance Company, Birmingham, twenty third-class carriages with wooden bodies. There is a good prospect of increased employment at the Doncaster workshops of the London and North-Eastern Railway Company, consequent upon that company having authorised the construction of 110 locomotives during 1929. The engines will comprise eight new "Pacific" class locomotives of the "Flying Scotsman" type; twelve six-coupled express engines for the East Anglia service; nine mixed traffic engines of the "Mogul" type; twenty-seven medium goods engines; thirty-four tank engines; and twenty shunting engines. With the exception of the twenty shunting engines, which are of new design and will be constructed by private contract, the whole programme will be carried out in the company's workshops, and it is understood that the work will be shared by Doncaster and Darlington.

The Virtues of Rationalisation.

Some interesting remarks on rationalisation were made by Mr. W. L. Hichens, the chairman of Cammell Laird and Co., Ltd., at the special meeting of shareholders of that company held on Monday, when ratification was given to provisional agreements made by the directors for the concentration of the commercial steel interests of Vickers, Vickers-Armstrongs, and Cammells in a new company called the English Steel Corporation, and also the concentration of the railway carriage and wagon manufacturing interests of Vickers and Cammells. Mr. Hichens pointed out that at the end of the war there were more steel works than work for them to do, and that that overcapacity had been increased by the policy of self-determination adopted in most countries. It was not likely, he said, that the demand for steel would again exceed capacity unless some important new uses for the material were discovered. If and when that happened—and he imagined it would—then the demand would jump ahead again. But in order to meet the stationary or contracting conditions now existing, it was necessary to make bigger combinations, so that, instead of putting down a large number of new plants, it would be possible to put down a smaller number calculated to suffice for the amount of work which was likely to be done. That seemed to be the principal argument in favour of the policy of amalgamation, which was known to-day as rationalisation. It meant that those businesses which were doing a kindred kind of work got together with the object of securing greater economy and efficiency. It did not mean that they would absorb everybody into their net, whether they were going to make economies for them or not. It did not mean that they aimed at a monopoly. Personally, he disliked a monopoly, and he hoped they would not see a monopoly in the steel industry. He added that the amalgamations now proposed were only a first step. He would not be satisfied if the policy which the shareholders were now asked to accept remained where it was. Already negotiations were proceeding in other directions, and there was some reorganisation, he thought, to be done within the groups that were now being formed.

Giant Stone Crushers.

Hadfields Ltd. report that they have had a satisfactory number of orders during the past twelve months for crushing plant and spare parts of stone-breaking and ore-crushing machinery. It has been necessary to make extensions to the workshops in the crushing machinery department in order to cope with the increase of work, and many large machine tools of the latest type have been added. Three large jaw type crushers are at present under construction for the Cauvery Metur Dam in India. This dam, when finished, will be the largest artificial reservoir in the world, and the crushers will be the largest of their class ever built in this country. Each of them will weigh 100 tons and will crush approximately 200 tons of stone per hour. They are built entirely of steel, have a feed opening measuring 54in. by 42in., and are capable of dealing with blocks of stone weighing over 2 tons each, and reducing them to 6in. cubes.

Ship Offer Not Accepted.

As I recently reported, Thos. W. Ward, Ltd., of Sheffield, a short time ago made an offer to the United States Shipping Board of £155,000 for a fleet of forty-five ships, with the intention, if they acquired the vessels, of bringing them over to this country and breaking them up in their own yards. It is believed, however, that this offer has not been accepted, and that the ships have been sold instead to the Union Shipbuilding Company, of Baltimore, whose tender amounted to only £84,700. The Boston Iron and Metal Company offered £137,000. The fact that the highest bid has not been accepted is regarded as indicating that the United States Shipping Board prefers the work of breaking up to be done in the United States, thus providing employment for American workers.

By-product Plant Closing.

The B Winning by-product plant of the Blackwell Colliery Company is to be closed, the directors having decided to concentrate upon the more modern works, which were recently installed at the A Winning colliery. The A Winning installation is one of the most up-to-date in the country, and has advantages over the older plant in quantity and cheapness of production. Both plants might have been kept in operation but for the depression in the coal trade, but it is stated that it is essential now to concentrate on economic production and eliminate all waste and loss. Over a hundred men will be unemployed.

In Lincolnshire.

The Lincolnshire Sugar Beet Company is making important developments at its Brigg factory. It is to install refining machinery which will enable cane sugar to be refined during the months when sugar beet is not available. It will thus be possible to employ 300 men all the year round. The machinery will be capable of producing 250 tons of refined cane sugar per day. If the experiment is successful, it is proposed to extend it, on an even bigger scale, to the factory at Bardney. An interesting replacement has been made at Pode Hole, near Spalding, where the Deeping Fen Drainage Trust has installed a new pumping engine to take the place of the old beam engines which have been in use since 1825. The engine is of 250 B.H.P., and was made by Mirrlees, Bickerton and Day, of Stockport, while the pump, which is of an entirely new type, is by Vickers-Armstrongs, Ltd., of Barrow. The pump is guaranteed to discharge 250 tons of water per minute, and will drain about 33,000 acres of low-lying land in Deeping Fen.

NORTH OF ENGLAND.

(From our own Correspondent.)

Northern Trade Revival.

INDUSTRIALISTS in the North of England enter upon the New Year in an atmosphere of optimism, and in the confident belief that the trade barometer will show a steady rise. A great deal of progress has yet to be made before anything like a normal state of affairs is reached, but there are definite signs that the corner has been turned, and industrialists, particularly those engaged in the iron and steel and shipbuilding trades, start the year with the knowledge that their order books are substantially better than at the beginnings of the past few years. This is due to a large extent to the successful operation of the steel rebates scheme, which has prompted shipbuilders and constructional engineers to make exclusive use of British-produced steel. As a result, continental products have been entirely eliminated. How important this is to the steel trade can be visualised when it is stated that the whole of the steel required for the building of vessels on the North-East Coast will be drawn from the immediate district. There is an old axiom in the North that when shipbuilders are prosperous, good times are assured for the iron and steel trades. Shipbuilding certainly appears to have entered upon a period of activity, so that the outlook for the other trades is distinctly bright. Increasing demands are, however, being made in other directions. Eighteen months ago the menace of the foreign producer was very real. Northern iron and steel firms were not only being undercut in continental markets, but were also being deprived of much business at home. Foreign makers are now, however, having a taste of that distressing drug—labour troubles. Their costs are rising, while the British manufacturer, by close concentration on the difficulties of the situation and by highly commendable sacrifices, has succeeded in bringing his down to a competitive level. On the North-East Coast the last month of 1928 was in many respects one of the most wonderful. There was a sudden spurt in the basic industry—coal—so long under a drear cloud of depression, and in the shipbuilding trades. Even if there is no boom, there is a widespread feeling that trade is on the upward curve once more definitely and certainly.

Cleveland Iron Trade.

Reviewing the course of events in the Cleveland pig iron trade during the past year, one is led to the conclusion that the natural advantages formerly enjoyed by Cleveland as a centre for cheap pig iron production are gradually slipping away, and that the manufacture of raw iron for the open market must remain no longer the principal occupation. The blast-furnaces in the Cleveland district, other than those associated with steel works, are now at a serious disadvantage, and for the most part cannot be operated at a profit. The consequence is that Cleveland has almost ceased to count as a centre for the export of pig iron, and whilst the invasion of the local market has been checked by rising costs abroad, the district is experiencing formidable competition from the Midlands. Iron ore can be quarried in Northamptonshire at a fraction of the cost of its recovery in the Cleveland district, and these economies are reflected in a difference of 8s. to 10s. per ton in the selling price of iron in the two areas. Another serious factor is that Midland producers are able to undersell the Cleveland ironmasters in Glasgow, and capture a substantial share of the Scottish trade, which, at one time, was looked upon as belonging exclusively to Cleveland. Even on Teesside, the Cleveland ironmasters have not been wholly immune from Midland competition. The import of foreign pig iron, which, until the early part of 1928, was a serious menace to local industries, has virtually ceased, but a few cargoes of iron have lately arrived in the Tees from Immingham at a price presumably competitive with the Cleveland product. Broadly, it may be said that during the past year Cleveland's production of pig iron has fallen to half the pre-war standard, the number of operating blast-furnaces to less than half the normal in the pre-war period, and the exports to no more than one-sixth of the figure in 1913. There has, however, been a greater diversion to steel production, and the manufacture of the finished product. It is in that direction that the salvation of the district would appear to lie. Prices of Cleveland pig iron have been practically stabilised throughout the year, and the ironmasters' system of agreed minimum quotations has now continued so long as to suggest that it may prove to be a permanent feature of the trade. The only change in the quoted prices of the various grades of Cleveland foundry and forge pig iron was made in March last, when the ironmasters were encouraged by an improved demand to make an advance of 1s. per ton. The average quoted price of No. 3 G.M.B. Cleveland pig iron to home consumers for 1928 has been 65s. 9·99d. per ton, compared with 73s. in 1927, 87s. 7·81d. per ton in 1926, and 72s. 5·19d. per ton in 1925. The average ascertained selling price for the year is 63s. 0·96d. per ton, compared with 71s. 1·6d. per ton in 1927.

Hematite Pig Iron.

Producers of East Coast hematite pig iron had an exceedingly trying time during the past twelve months, and incurred some heavy losses. Normally, the value of East Coast hematite is about 8s. to 10s. per ton above that of the standard No. 3 Cleveland pig iron; at the moment, the margin between the quoted prices is only 5s. and though the minimum variation between the two figures during the past year was nominally 3s., it was, in fact, down to 1s. 6d. per ton on the basis of actual selling prices. The truth is that hematite iron is going out of favour. At one time steel makers found it indispensable. Now the development of the open-hearth process enables manufacturers to charge the steel furnaces with common basic or forge iron and obtain quite satisfactory results. At the beginning of the year there were thirteen blast-furnaces, distributed over six different plants, producing East Coast hematite, but at the close only three firms were engaged and eight blast-furnaces in operation. Gjers, Mills and Co., who were idle nearly the whole of the year, have arranged to restart two blast-furnaces at their Ayresome Ironworks at the end of this week, so that the position at the beginning of the New Year will be a little better. Quoted prices of East Coast hematite fluctuated within very narrow limits during the year. For the first quarter the ruling quotation was 70s. In April it fell to 69s., and while it has never nominally fallen below that figure, and has since advanced to 71s., sales were effected during the summer months at 67s. 6d. per ton, and even less.

Manufactured Iron and Steel Trade.

In the manufactured iron and steel trade the year closed with fairly satisfactory order books, and an optimistic view is taken of the outlook. The last three months of 1928 witnessed a remarkable revival of business confidence, and steel makers observed with great satisfaction the rush of orders for new tonnage which gives promise of busier times for North-East Coast shipyards. The export trade is improving, conditions in this country are more favourable, and costs of production are changing in a manner which tends to increase the competitive power of British producers. Prices of finished products were more or less stabilised during the year, and a reduction in the prices of semis a few months ago had the effect of diverting

a good deal of work to this district which would otherwise have gone abroad. As compared with a year ago steel production costs have been reduced by about 10s. per ton and the new rail rates, which came into operation in December, afford additional relief of something like 3s. to 4s. a ton. On the other hand, continental steels have advanced by from 8s. to 20s. per ton since May last. The steel output on the North-East Coast for the past year is estimated at 1,832,000 tons, as compared with 2,233,700 tons in 1927. Most of the steel works resumed operations on Monday, and have continued without a break for the New Year holidays

The Coal Trade.

There are signs of a return to normal prosperity in the Northern coal trade. Operations during the past twelve months show that matters have improved in both Northumberland and Durham. The improvement is represented in various ways. Values have been maintained where they have not actually improved; quotations for most classes of fuel are more in accordance with facts, and not so nominal as was the case at the beginning of the year; coal shipments have increased; and labour relations are better than for many years past. The selling organisations which sprung up in other coal areas had some effect on the trade in this area, but the results have not been so serious as was at first thought likely. In Northumberland and Durham there was also a definite movement to check the ruinous losses made by normal methods of trading in an abnormal market, and, without any of the elaborate machinery of the Midlands, the Northern coalowners and exporters have certainly effected a big change in the position and regained prestige on the Continent, which was on the way towards being lost. They have simply adopted, by mutual agreement, a firmer attitude towards the buyer. Panicky reductions, out of all proportion to values, in order to gain trade, have been stopped. At first, the stiffening attitude of sellers was a very delicate operation, but, so far as can be seen, it has been and is successful. This week market operations have been interrupted by the holidays, but the position continues to give encouragement with a good trade definitely in prospect.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

DURING the year 1928 the number of vessels launched from Clyde yards amounted to 240, with an aggregate tonnage of 604,540 tons, compared with 274 vessels of 462,510 tons aggregate in 1927, and 370 vessels of 756,980 tons, launched in 1913, the record year. The largest vessels launched during 1928 were three of the "Duchess" liners for the Canadian Pacific Railway, each of about 20,000 tons. The figures for 1928 indicate a fair recovery compared with the preceding year, but cannot be taken to represent a satisfactory state of prosperity. A fair number of orders have been placed during recent months, and there are expectations of further contracts in the near future. The rate of output during 1928 has caused a rapid increase of empty berths, and the flow of fresh orders would require to be accelerated to keep pace with output and to provide the extra work necessary to put the industry on a sound basis.

Steel and Iron.

Conditions in the steel trade have improved a little of late. Works with shipyard connections have been fairly busy, and while there are others not so well placed, the outlook is more promising generally. Recent shipbuilding orders have caused a change in the outlook, and distinct hopes are entertained of a fair measure of activity for some months to come. Trade is also expected to benefit from the operation of the de-rating scheme. Works meanwhile have been steadily engaged in the production of light gauges and galvanised descriptions also have had a fairly regular turnover at firm prices. Heavy sheets have been rather quiet, however. Tube makers are generally busy. Bar iron and pig iron are in poor demand, and the comparatively poor output of each is in nowise taxed. Re-rolled steel bars maintain a fair measure of activity, and are quoted on a firm level at £7 15s. home and £7 10s. per ton export. On the whole, during the past week buying has been on a small scale, consumers, as a rule, being anxious to carry forward as light stocks as possible. Only small lots for immediate use have therefore changed hands.

Exports and Imports.

During last week 2750 tons of iron ore, and 3500 tons of steel and iron were unloaded at Glasgow Harbour; also about 600 tons of scrap iron from India and Port Sudan. Exports of steel and iron amounted to 6300 tons.

Coals.

So far as business for January delivery is concerned, the market continued quiet during the past week. The collieries have been busy, however, clearing off deliveries due prior to the holidays, and practically all grades of fuel were scarce and difficult to obtain. Prices therefore maintained a firm level.

Advance in Household Coal Prices.

It is announced that the Scottish coal companies are making a general advance in the price of household coal from January 3rd as follows:—All qualities under 20s. per ton at the pits to be increased by 1s. 6d. per ton; and all qualities over 20s. by 1s. per ton. At present the wholesale prices at the pits range from 17s. to 25s. per ton, according to quality. If the increase is followed by retailers, the price will probably be increased by 1d. to 1½d. per cwt.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

1928–1929.

A RETROSPECT of trade for 1928, so far as this district is concerned, is a very gloomy proceeding. The tin-plate trade comes out about as well as any section, but all that can be said of steel and iron is that it has been extremely quiet and unprofitable, while, as regards ship repairing, the only satisfaction that can be derived is that it has been a shade better than it was in 1927. So far as the coal trade is concerned, 1928 can be written down as having been one of the most depressing in history. It was not at all a good year for the middleman—that is, the genuine merchant, who takes c.i.f. risks—while colliery undertakings have never had a more difficult time. Quite a number of undertakings have gone under in the struggle, and have been absorbed by other concerns at prices which a year or two ago would have been rejected as ridiculously low. The coal strike of 1926, followed by a year or more of bad trade, absorbed the reserves of practically all colliery companies, and, with no more financial support forthcoming, it was inevitable that a number of concerns should fail to be able to carry on. The demand for coal has been so far below production that prices almost throughout the year have been unremunerative, for by far the bulk of undertakings. There is no doubt that prices under the strain of severe competition would have fallen to a lower level, but for the fact that the coalowners loyally stood by a scheme of a purely voluntary character of minimum prices. The scheme fell short of what was originally aimed at, viz., regulation of output in combination with minimum prices; but the coalowners are still working on it, and possibly a more comprehensive scheme will be adopted before long. In the circumstances, coal prices have displayed no feature, as they have been more or less stationary; only during isolated periods have collieries been able to quote 3d. to 6d. above their schedule price. When the figures for the whole of the past year become available, it will probably be found that exports from this district were less by about two and three-quarters of a million tons, as compared with 1927. One satisfactory feature is, however, that the end of the year showed the demand for coal to approximate more nearly to the supply, while there was evidence that the competition with continental coals, notably those of Germany and Poland, was less intense, for the reason that, while production costs in this district have been worked down to a minimum, those of continental producers have increased. The decline in the coal export trade has, of course, reacted on associated industries and on labour. It is true that there has been no change in the wage rate of the miners in 1928, but, unfortunately, the irregularity of work has been pronounced and the distress among the workers has been unprecedented. Taking trade as a whole, the returns of the Great Western Railway Company, as they concern the ports of Newport, Cardiff, Penarth, Barry, Port Talbot, and Swansea, are likely to show, for the whole year, a falling off in exports and imports of round about 3,000,000 tons, as compared with 1927. In the case of shipping, returns of the average outward coal freights for last year were lower than for the preceding year; but as regards 1929 the outlook is certainly better, and for shipping in particular, there is a feeling of quiet confidence prevailing that the coal and tin-plate trades will mark an improvement, and that should react favourably on ship repairing.

Miners' Wages.

The award of the independent chairman of the South Wales Coal Conciliation Board, Sir Francis Taylor, on the applications of the coalowners' and the workmen's representatives for a revision of the wage rate, has been received, and is on the lines expected. The award means that the wage rate remains unaltered, viz., 28 per cent. above the 1915 standard rates.

105-Ton Stator.

The heaviest piece of machinery ever carried by rail in this district was placed on the sidings of the South Wales Electrical Power Distribution Company at Treforest on Sunday night last. It was an electrical stator, weighing 105 tons, from the Heaton Works, Newcastle-on-Tyne, of C. A. Parsons and Co., Ltd. This stator is part of a turbo-alternator, and forms the latest addition to the plant to be installed in the power station in order to supply electrical energy over an area of about 1000 square miles. The difficulty of transporting the stator provided a difficult problem, as the journey could only be made on Sundays, and consequently was made in three stages by special trains. The dimensions of the stator are as follows:—Length, 16ft. 3in.; breadth, 11ft. 3in.; height, 10ft. 5in. It was 11½in. out of gauge on both sides, and the height of the load was 4in. in excess of the gauge between Cardiff and its destination. The total length of the three special wagons carrying the stator and the cantilever girders was 130ft., with a tare weight of 233 tons; 40 tons of pig iron were required to act as balance-weights.

Current Business.

Business has not yet settled down following the holidays, but the position of collieries is more satisfactory than it was immediately before the Christmas vacation, as tonnage has come along much better. On Monday the number of idle tipping appliances coincided with the number of steamers waiting to berth, so that there was a good outlet for coals. Collieries are well booked up for the next week or so, and considering the holiday conditions still more or less prevailing, the chartering of tonnage has been fairly satisfactory, and orders to be executed are on a good scale. The general tone of the coal market is, for the moment, very steady, if not strong in places, for prompt supplies, though prices are somewhat nominal in character. Last week shipments were, of course, much affected by the holidays, the total being round about 228,000 tons, as against over 490,000 tons in the preceding week.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DR. A. L. RAWLINGS, late principal scientific assistant in the Department of Scientific Research at the Admiralty, has joined the Sperry Gyroscope Company, Ltd., in the capacity of chief engineer.

WALWORTH, Ltd., of 90–96, Union-street, Southwark, London, S.E. 1, asks us to announce that Mr. C. R. Averill has been elected managing director of the company, succeeding Mr. V. L. Young, who goes to the general sales office of the company in New York.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., and the Electric Furnace Company, Ltd.—which are sole licensees for the British Ajax-Northrup patents—ask us to announce that they have entered into an agreement whereby each company has the right to manufacture and supply coreless induction furnaces incorporating the Ajax-Northrup and Metropolitan-Vickers patents.

MR. T. L. MILLER, consulting engineer, of 316, Royal Liver-buildings, Liverpool, asks us to announce that, following his retirement, he has transferred his practice and all office records to Mr. A. B. Mallinson, M.I. Mech. E., M.I.E.E., of Worsley-street, Salford, and St. James' House, Brazennose-street, Manchester. Mr. Miller's Liverpool office will be closed and Mr. Mallinson will deal with any inquiries from Manchester.

CONTRACTS.

ALFRED HERBERT, Ltd., asks us to announce that its licensees in Belgium have secured a repeat order for Atritor pulverisers from the Fabrique de Soie Artificielle de Tubize, Tubize.

BLACKSTONE AND CO., Ltd., of Stamford, has supplied to the Jersey Granite and Concrete Company, Ltd., of St. John's, Jersey, Blackstone "spring injection" heavy-fuel-oil engines to the extent of 450 B.H.P.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., announce that a contract has been signed between them and the Chilean Naval Commission in London acting on behalf of the Chilean Government for the construction of two oil-tank steamers of a special type, for working with the fleet.

CAMMELL LAIRD AND CO., Ltd., ask us to announce that the following orders have been placed by the Siamese Royal State Railways for:—(*a*) Thirty coaches and vans with steel bodies, with the Midland Railway Carriage and Wagon Company, Ltd., of Birmingham; (*b*) for twenty third-class coaches with wooden bodies with the Metropolitan Carriage Wagon and Finance Company Ltd. of Birmingham; and (*c*) for sixteen coaches with wooden bodies, with Cravens Railway Carriage and Wagon Company, Ltd., of Sheffield. These orders were obtained in face of foreign competition.

CALENDARS, DIARIES, &c., FOR 1929.

AITON AND CO., Ltd., Derby.—Wall calendar with monthly tear-off slips.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., Kinnaird House, Pall Mall East, S.W. 1.—Wall calendar with tear-off sheets.

A. BORSIG G.M.B.H., Berlin-Tegel.—Desk diary.

BRITISH INSULATED CABLES, Ltd., Prescot, Lancs.—Copy pocket volt calculator.

CLAYTON, SON AND CO., Ltd., Hunslet, Leeds.—Wall calendar with monthly tear-off sheets.

GEAR GRINDING COMPANY, Ltd., Handsworth, Birmingham.—Wall calendar with monthly tear-off sheets.

HILDICK AND HILDICK, Walsall.—Wall calendar with daily tear-off sheets.

LE GRAND, SUTCLIFF AND GELL, Ltd., Southall, W.—Wall calendar with monthly tear-off sheets.

MARCONIPHONE COMPANY, Ltd., London.—Wall calendar with daily tear-off slips.

MAWDSLEY'S, Ltd., Zone Works, Dursley.—Wall calendar with monthly tear-off sheets.

NOAKES BROTHERS, Ltd., 19, St. Bride-street, Ludgate-circus, London, E.C. 4.—Wall calendar with monthly tear-off sheets.

HENRY SIMON, Ltd., Mount-street, Manchester.—Desk calendar with daily tear-off sheets.

S. S. STOTT AND CO., Laneside Foundry, Haslingden.—Wall calendar with monthly tear-off sheets.

SWISS LOCOMOTIVE AND MACHINE WORKS, Winterthur.—Wall calendar with monthly tear-off sheets.

THAMES TUBE AND FITTINGS COMPANY (GT. BRITAIN), Ltd., Lots-road, Chelsea, S.W. 10.—Pocket diary.

J. I. THORNYCROFT AND CO., Ltd., Thornycroft House, S.W. 1.—Pocket wallet and calendar.

C. TOWNSEND HOOK AND CO., Ltd., 102–4, Queen Victoria-street, London, E.C. 4.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, 2, Norfolk-street, Strand, W.C. 2.—Pocket diary.

ED. WOOD AND CO., Ltd., Ocean Ironworks, Manchester.—Wall calendar with monthly tear-off sheets.

ELECTRICALLY OPERATED NAVVY FOR A BRICKWORKS.—Ruston and Hornsby, Ltd., of Lincoln, ask us to point out that, in condensing, for the paragraph which appeared on page 712 of our last issue, the information which they sent to us regarding the electrically operated navvy for which they have received an order from the London Brick Company and Forders, Ltd., we omitted the essential words "employed in any brickworks." The first part of the paragraph should therefore read:—"It is claimed that the electrically operated navvy which Ruston and Hornsby, Ltd., are supplying to the London Brick Company and Forders, Ltd., will be the largest of its kind employed in any brickworks."

THOS. W. WARD, LTD.: JUBILEE.—We are asked to announce that the share distribution which was promised by Mr. Joseph Ward at the jubilee dinner of the firm, and to which we referred at the time, is to be considerably augmented, Messrs. T. Leonard Ward, Frank Joseph Ward, Alan B. Ward, Arthur J. Ward, Mrs. Gallimore and Miss G. M. Ward all having promised to participate in the distribution by each contributing a block of shares. This enables a much larger number to be included, and it is proposed to distribute to practically all the directors, staff, foremen and workmen alike, who have been in the firm's employ fifteen years and over, and are still in the company's service, ordinary shares at the ratio of one share for each completed year of service.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/– to 19/–
(1) Spanish	21/–
(1) N. African	21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 12 0	3 12 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 16 0	—
Forge	2 11 6 to 2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0	—
Forge	2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 6	—
No. 4 Forge	2 17 6	—
Basic	3 0 0	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (*a*), 4 2 6 (*b*), 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
MIDLANDS—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	6 17 6 and 7 12 6	—
Soft Basic	6 12 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 7 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/– to 18/3
Block Tin (cash)	225 15 0
,, ,, (three months)	225 10 0
Copper (cash)	74 10 0
,, (three months)	73 5 0
Spanish Lead (cash)	22 0 0
,, ,, (three months)	22 6 3
Spelter (cash)	25 17 6
,, (three months)	26 15 0
MANCHESTER—	
Copper, Best Selected Ingots	76 15 0
,, Electrolytic	77 15 0
,, Strong Sheets	100 0 0
,, Tubes (Basis Price), lb.	0 1 2
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	23 10 0
,, Foreign	22 10 0
Spelter	27 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/–
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/–
,, ,, ,, 1 p.c. carbon	£37 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£42 0 0	17/–
,, ,, ,, carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/– per unit	
,, Vanadium	14/– per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/– per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
,, ,, Ell	16/–
,, ,, Splint	16/3 to 17/–
,, ,, Trebles	14/9 to 15/6
,, ,, Doubles	13/9 to 14/–
,, ,, Singles	13/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	16/6
,, ,, Trebles	16/–
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/6
Screened Navigation	18/–
Trebles	15/6 to 16/6
Doubles	13/3 to 13/9
Singles	12/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/6
Secondary Steam	13/–
Trebles	15/6
Doubles	13/6 to 13/9
Singles	12/9

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	23/–
Household	38/6 to 51/–
Coke	22/–
NORTHUMBERLAND—	
Best Steams	14/3
Second Steams	13/– to 13/6
Steam Smalls	9/–
Unscreened	11/9 to 12/–
Household	21/– to 27/–
DURHAM—	
Best Gas	14/9
Second	13/3 to 13/6
Household	21/– to 27/–
Foundry Coke	18/6 to 19/6

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	26/– to 27/6	—
Derbyshire Best Bright House	23/– to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/– to 18/–	—
,, ,, Nuts	16/– to 18/–	—
Yorkshire Hards	14/6 to 16/–	—
Derbyshire Hards	14/6 to 16/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/–	—
Smalls	3/6 to 4/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/– to 19/6

(9) SOUTH WALES.

CARDIFF— Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/– to 19/3
Best Dry Large	18/6 to 19/–
Ordinary Dry Large	17/6 to 18/–
Best Black Vein Large	17/9 to 18/–
Western Valley Large	17/3 to 17/6
Best Eastern Valley Large	17/– to 17/3
Ordinary Eastern Valley Large	16/6 to 16/9
Best Steam Smalls	12/9 to 13/3
Ordinary Smalls	10/6 to 12/6
Washed Nuts	18/– to 24/–
No. 3 Rhondda Large	19/6 to 20/–
,, ,, Smalls	14/– to 14/6
No. 2 ,, Large	16/– to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/– to 12/–
Foundry Coke (export)	27/– to 37/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	27/3 to 27/6
SWANSEA— Anthracite Coals:	
Best Big Vein Large	34/– to 35/6
Seconds	24/6 to 28/6
Red Vein	22/– to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	36/– to 43/6
Beans	23/6 to 25/–
Peas	16/6 to 17/6
Breaker Duff	8/– to 8/6
Rubbly Culm	9/– to 9/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 12/6
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Wages.

DURING the long period of monetary depreciation, wages were adjusted almost automatically to the new values, and when the stabilisation took place, it was expected that the upward movement in wages would cease. That would probably have been the case if it were not for the continuous increase in the price of commodities, which is quite independent of the stabilisation, and may be attributed more especially to a fiscal policy that has rarefied produce on the home market by facilitating exports and checking imports. There is, consequently, a recrudescence of the wages' agitation, more particularly at the collieries, where it was hoped that the recent compromise giving the men partial satisfaction would have been faithfully observed. It was so in the Nord and the Pas de Calais, but in the Loire coalfield a strike has been declared for the full advance claimed. The strike is not general in that district, although it is serious enough to cause trouble to coalowners who give their reasons for resisting any further claim for higher wages. On account of the difficulty of winning the coal, the production per man is much less than in other coalfields, and it is much more difficult to dispose of the coal at a profitable price on account especially of the competition of British coal in the south-western part of the country. Notwithstanding the efforts that have been made to cheapen the transport of French coal the attempts to meet the competition have failed, and in the south-western markets British coal is regaining its ascendancy.

Inland Waterways.

As the City of Paris is interested directly in the distribution of gas, water and electricity, it is the largest consumer of coal, and it therefore favours every scheme which aims at cheapening the fuel, notably by the new canal which will shorten the distance between Paris and the collieries in the Nord. The construction of the canal was decided upon ten years ago, and since than a good deal of work has been carried out. The port at Pantin, a northern suburb of Paris, is nearly completed, and the Ourcq Canal has been widened and deepened during its passage through the Department of the Seine. Further progress depends upon what will be done by the State and by the authorities outside the Department. The Ourcq Canal will join the proposed Nord Canal, which will be constructed between La Rosée and Montemauque, where it will connect up with the lateral Oise Canal. This will reduce the distance for the transport of coal from the Nord to Paris by 50 miles, as compared with the actual distance by the Oise and the Seine. The Port of Pantin will be in communication with the Seine, which is being deepened to allow of seagoing ships reaching Paris.

Naval Construction.

Under the programme of naval construction the vessels to be put on the stocks during the present year comprise one cruiser, six destroyers, one submarine minelayer, six first-class submarines, two "avisos" and two oil tankers. Credits will also be asked for to permit of the construction of four coast defence submarines of 600 tons. The total displacement of all these vessels will be about 48,000 tons, and the credits, amounting to about 680 million francs, will be spread over a period of five years. The 10,000-ton cruiser will be identical with the other cruisers now under construction. The destroyer will be similar to the "Tigre," and of 2400 tons. The submarine minelayer will be of 720 tons, and the first-class submarine of 1460 tons. These latter will be of the Pascal type.

A Fuel Combine.

The various groups of collieries in the Nord and the Pas de Calais are so closely associated for the protection of their common interests that the operations of many of them, so far as the disposal of coal is concerned, are almost equivalent to an amalgamation. In Belgium the work of concentration has been carried still further. The negotiations for the constitution of a Syndicat des Cokes et Charbons à Cokes and of a Comptoir des Charbons Industriels have been brought to a satisfactory conclusion, and the two companies, under the general direction of Monsieur Herman Capiau, will start operations on April 1st next. The Syndicat des Cokes comprises all the coke oven owners except the metallurgical concerns producing coke for their own consumption, and the Comptoir des Charbons Industriels includes all the collieries producing industrial fuel, to the exclusion of those in the Liége district, which prefer to organise themselves independently.

Coal Treatment.

Another address on the chemical treatment of coal was delivered recently before the Société des Ingénieurs Civils by Monsieur Charles Berthelot, who reviewed the progress that was being accomplished abroad and insisted upon the necessity of a close co-operation of all branches of industry in order to obtain similar results in this country. A fact that dominated the situation was an excess production of 80 million tons of coal in the whole of Europe, and the growing necessity of nitrogeneous fertilisers and liquid fuel that could be supplied by coal. This chemical treatment of coal raised new problems, such as the means of disposing of the production of metallurgical cokes and of coke-oven gases. In France something had already been done in this direction by the synthetical treatment of coke-oven gases for the production of ammonia and methylic alcohol. Unfortunately, the commercial success of synthetic alcohol was hampered by taxation, and little could be done until the State recognised the necessity of encouraging that branch of industry as a means of competing with imported liquid fuels. Monsieur Berthelot did not believe that the Germans would meet with success in their efforts to distribute coke oven gas over considerable distances. He expected that the surplus coke would be largely employed for the production of water gas, and that that would open up further possibilities in the way of producing synthetically liquid fuels or ammonia.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

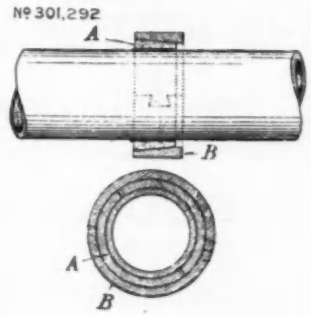
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

301,292. August 7th, 1928.—SUPPORTS FOR THE BAFFLES OF WATER-TUBE BOILERS, *The Stirling Boiler Company, Ltd.*, 32, *Farringdon-street, London, E.C.* 4.

This device is for the support of the baffles of boilers with steeply inclined water tubes. It comprises an internal split ring A and an external collar B, both of which have conical

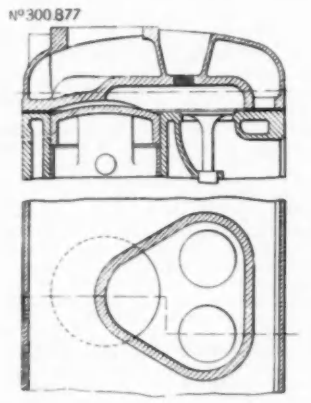


surfaces, so that the inner ring may be gripped tightly on the tube. It is explained that the surfaces of the rings are such as to be conducive to the rapid transfer of heat, and that the inner ring may be lightly spot welded to the tube to prevent it slipping while the outer ring is being driven home.—*November 29th*, 1928.

INTERNAL COMBUSTION ENGINES.

300,877. April 26th, 1928.—INTERNAL COMBUSTION ENGINES, Crossley Motors, Ltd., and S. E. Crooke, Gorton, Manchester.

This invention relates to internal combustion engines of the type in which the inlet and exhaust valves of each cylinder are arranged side by side in a common space or pocket constituting the combustion chamber formed by a recess in the cylinder head, and in which the clearance between the cylinder head and piston crown is a minimum and the passage communicating between

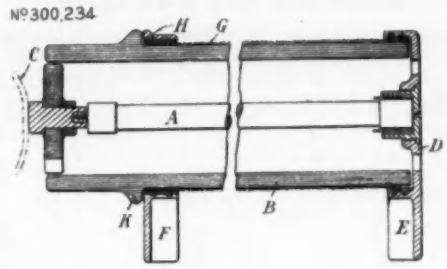


the clearance space and the combustion chamber has its minimum cross section approximately equal to that of the valve inlet port. The piston crown is made of a rounded shape constituting part of a sphere, and the cylinder head is shaped to correspond. The clearance between the head and crown is the minimum requisite mechanically. With this construction the inventors find that they can obtain a greater power output than with a piston crown and head which are not spherically or conically shaped.—*November 22nd*, 1928.

ELECTRICAL APPLIANCES.

300,234. June 22nd, 1927.—ELECTRIC PROTECTIVE DEVICES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; John Gale Wellings, of "Ricky," London-road, Dunchurch, Rugby; and Charles William Wood, of 12, Highfield-avenue, Wembley Park, Middlesex.

It is common practice to connect electrical apparatus, such as potential transformers and, in some cases, small power transformers, to a supply circuit directly by means of a fuse and resistor member connected in series, the fuse operating to disconnect the apparatus in predetermined fault conditions, and the resistor operating to limit fault current to a value which the fuse can safely interrupt. In the case of high-potential apparatus, however, for example, in 33 kV systems, if the fusible element is in the form of a thin wire, it is liable to give rise to corona discharge. This may cause the corrosion or deterioration of the wire, with the result that the fuse may "blow" at a lower value of current than that for which it is designed; or the fuse may corrode away altogether. It is to obviate these disadvantages that the invention is particularly applicable. A cartridge-type fuse A is placed inside a porcelain tube B. The spring contact C collects the current from one end of the fuse, whilst the other end is mounted in a metal cap screwed into the metal end plate D, provided with a supporting clip E. A second supporting clip is provided at F. A resistor coil G is wound on the periphery of the tube, one end of the coil being connected to the supporting clip F at the point H, whilst the other end of the coil is connected to the plate D. When the device is used to protect a transformer the supporting clip F is preferably connected to the transformer. With these connections the fuse and the whole of the resistor winding will all normally be at the same potential. When, however, a fault occurs in the transformer winding or other apparatus protected, the end of the resistor connected thereto—the connection H in the case assumed—will be at earth potential, and on the blowing of the fuse there will be a

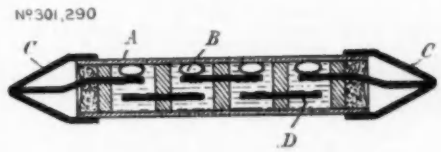


potential difference equal to the line voltage to earth. It is on account of this that the insulating tube B extends beyond the resistor, but the provision of the shoulder K enables the length of the extension to be appreciably reduced.—*November 22nd*, 1928.

TELEGRAPHS AND TELEPHONES.

301,290. August 29th, 1927.—GRID CONTROLS FOR THERMIONIC ELECTRIC VALVES, Robert Kapp, of 3, Rue Schertz, Strasbourg-Neudorf, Bas-Rhin, France.

The grid bias battery described in this specification consists of a tubular casing divided into a number of cells. The casing shown at A is made of insulating material and is divided into

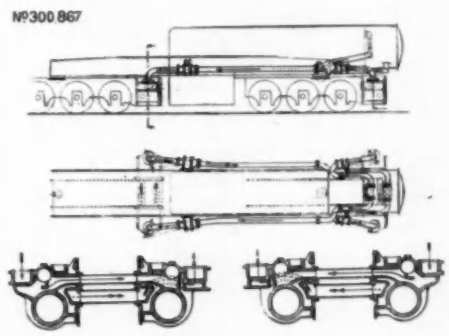


four compartments which, with the exception of small air bubbles B, are filled with electrolyte. The ends of the tube are fitted with conical caps C which enable the battery to be sprung into position between terminal clips. The electrodes, which are in the form of wires or strips D, are carried by the caps C and by the partitions as shown. Two other forms of construction are described.—*November 29th*, 1928.

LOCOMOTIVES.

300,867. March 28th, 1928.—STEAM PIPE CONNECTIONS FOR ARTICULATED ENGINES, G. Goldschmid, 3, Place Stéphanie, Brussels, Belgium; and A. Weber, 22, rue Omer Lefebvre, La Louvière, Belgium.

The object of this invention is to simplify the pipe connections of articulated locomotives, which necessarily involve ball joints. This is effected by providing a steam pipe with appropriate

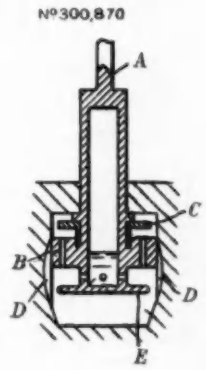


ball joints along one side of the engine and an exhaust pipe on the other side, while the steam and exhaust chests of the cylinders of each engine are interconnected by rigid pipes. The flow of the steam can be followed in the illustration with the assistance of the arrows. The single-headed arrows show the path of the live steam and those with double heads the direction of the exhaust.—*November 22nd*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

300,870. April 5th, 1928.—DROP HAMMERS, Dr. J. Urbanek, 13, Karlsplatz, Vienna IV., Austria.

This invention is concerned with what might be described as



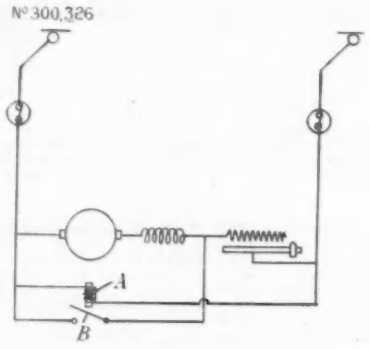
a dashpot connection between the rod and tup of a drop hammer. The rod A is provided with a piston B working within a cylinder in the tup. This piston is perforated and the perforations may be closed on the upstroke by the plate valve C, so as to increase

the damping action, which is then dependent on the grooves D D in the cylinder walls. On the downstroke the auxiliary piston E comes into action, in conjunction with the tapering lower part of the bore of the cylinder, to give a graduated damping effect.—*November 22nd*, 1928.

MOTOR CARS AND ROAD TRAFFIC.

300,326. August 23rd, 1927.—A SAFETY DEVICE FOR ELECTRICALLY DRIVEN VEHICLES, William Arthur Stevens, of "Castlemaine," London-road, Maidstone.

This specification describes a scheme for preventing electric rail or trackless trolley vehicles from running backwards at full speed on hills in the event of failure of the supply owing to the trolley pole coming off the line, or as the result of the circuit

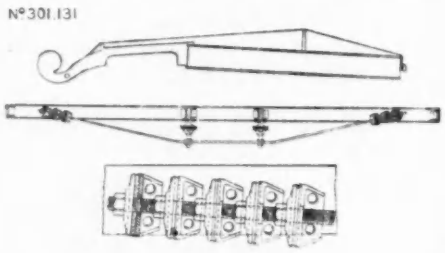


breakers opening or other causes. In the event of the supply failing the magnet winding A loses its excitation and the contactor B closes. Thus when the vehicle begins to run downhill the motor becomes a generator and sends a heavy current through the circuit completed by the contactor. The braking effect thus produced limits the speed to about 2 or 3 miles per hour.—*November 15th*, 1928.

TRAMWAYS AND RAILWAYS.

301,131. September 5th, 1927.—ABSORBING THE VIBRATIONS OF RAILWAY CARRIAGES, G. Spencer, Moulton and Co., Ltd., and R. T. Glascodine, 2, Central-buildings, Westminster.

The inventors liken a railway carriage to a violin, in so far that its frame may be taken to represent the body of the violin

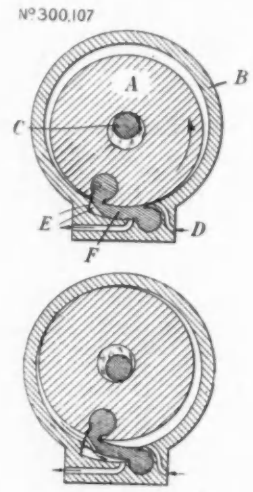


and the tension bars the strings, with the result that small vibrations set up a resonance in the carriage, to the discomfort of the passengers. As a consequence, they suggest that "india-rubber" should be "used in any position in the system so as to nullify the tendency to vibration set up in the system." The drawing illustrates the analogy and a method of applying rubber pads to a tension bar.—*November 29th*, 1928.

MISCELLANEOUS.

300,107. June 26th, 1928.—ROTARY ENGINE, G. Güttner, Wichertstrasse 19, Berlin, N. 113, Germany.

This "engine," or rather compressor, is of the type in which a rotor A rolls round within a casing B on an excentric C. The



fluid to be compressed enters at D and is discharged at E. The chief peculiarity lies in the abutment F, which separates the inlet and outlet sides of the casing. It is, as will be seen, articulated to both parts and incidentally acts as a delivery valve.—*November 28th*, 1928.

300,464. April 23rd, 1928.—A PROCESS OF CURING CEMENTING MATERIALS, L. Mellersh-Jackson, 28, Southampton-buildings, Chancery-lane, London, W.C. 2.

In modern cement concrete construction it is desirable to retard the evaporation of water from the concrete, after it is placed, and, during the curing period, in order to ensure sufficient hydration of the cement and thus produce a concrete of maximum strength. In the construction of concrete roadways this has, the inventors say, been imperfectly accomplished by covering the freshly laid concrete with blankets, straw or earth, which in each case must be frequently wetted to be effective. The invention involves the fact that concrete, if treated, after it is finished, with a water-external-phase bituminous emulsion, such as is often called in paving practice "cold repair cement," such emulsion will effectually prevent evaporation of the water contained in the concrete during the curing period and the concrete will cure without hair cracking, and when cured will be found to have greatly increased strength, durability and resistance to weathering as compared to concrete treated by methods heretofore known. Preferably, the film of emulsion is applied as soon as practical after the cement or concrete is laid and finished, but in any event it must be applied before the concrete has set.—*November 15th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF ELECTRICAL ENGINEERS. — Savoy-place, Victoria Embankment, London, W.C. 2. Meter and Instrument Section Meeting. Discussion on "Precautions in the Use of Standard Instruments," to be opened with a short paper by Mr. W. H. Lawes. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Ordinary meeting. Paper, "The Geared Steam Locomotive," by Mr. K. W. Willans. 7.30 p.m.

SATURDAY, JANUARY 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. "Wood Patterns from the Patternmaker's and the Moulder's Point of View," by Mr. F. C. Edwards. 4 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, London, W. 1. Juvenile Lecture, "The Ear and What it Does," by Mr. Alexander Wood. 3 p.m.

MONDAY, JANUARY 7TH.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College. "The Manufacture of Boilers and Radiators for Central Heating," illustrated by cinematograph film and lantern slides, by Mr. W. Button. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Modern Problems of Engine Lubrication," by Mr. L. H. Pomeroy. 6.45 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, Westminster, S.W. 1. "Some Notes on the Caaring Cross Bridge Problem," illustrated by lantern slides, by Mr. A. Norman Gerrard. 8 p.m.

MONDAY TO SATURDAY, JANUARY 7TH TO 12TH.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.—Belle Vue, Longsight, Manchester. Exhibition and Demonstration of Industrial Electric Heating Apparatus. Open 2 p.m. to 9 p.m. daily.

TUESDAY, JANUARY 8TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. "The Diesel Engine for Passenger Ships and Fast Cargo Liners," by Mr. J. Calderwood. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Coil Ignition," by Dr. F. W. Lanchester. 7.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Graduates' meeting. "Hints on Small Tool Design and Maintenance," by Mr. D. Allister. 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Paper for discussion, "George the Fifth Bridge, Glasgow," by Mr. T. P. M. Somers. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—The Royal Technical College, Glasgow. "The Electrical Equipment of X-ray Apparatus," by Mr. L. G. H. Sarsfield. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Geophysical Surveying," by Mr. W. H. Fordham. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, London, W. 1. Juvenile Lecture, "How Sounds are Recorded and Reproduced," by Mr. Alexander Wood. 3 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Annual General meeting. Presidential address. 7.30 p.m.

WEDNESDAY, JANUARY 9TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—In the Thomas Café, High-street, Swansea. "Pulverised Coal in Metallurgy," by Mr. G. E. K. Blythe. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Students' meeting. Institution Lecture, "The Development of the Generation and Distribution of Electric Power in the British Isles," by Mr. Archibald Page. 6.30 p.m.

THURSDAY, JANUARY 10TH.

BRITISH ASSOCIATION OF REFRIGERATION.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "Some Possible Developments in Marine Refrigeration," with lantern illustrations, by Mr. G. W. Daniels. 5.30 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "The Lead Industry," by Mr. H. C. Lancaster. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. "Mistakes in Mechanics," by Mr. W. J. Tennant. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Cavendish Café, Cornmarket, Derby. Graduates' meeting. "A Few Notes on Service," by Mr. W. S. Bull; and "Headlights," by Mr. F. J. Allen. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Hotel, Mill-street, Luton. Graduates' meeting. Address by Mr. A. J. Hancock. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. Ordinary meeting. General discussion on "The Anticipation of Demand and the Economic Selection, Provision and Layout of Plant," with introductory papers by Captain J. M. Donaldson and Mr. J. G. Hines. 6 p.m.

FRIDAY, JANUARY 11TH.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Developments in Spraying Apparatus," by Mr. F. E. Webb. Exhibits and demonstrations. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Midland Hotel, Manchester. Annual Dinner. 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "The Rational Utilisation of Coal: (*a*) Coal Used in its Raw State," by Mr. W. J. Drummond; (*b*) "Fuels Obtained by the Treatment of Coal," by Mr. W. T. K. Braunholtz. 6 p.m.

SOCIETY OF CHEMICAL INDUSTRY: CHEMICAL ENGINEERING GROUP.—In the House of the Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2. "The Relative Safeties of Mild and High-tensile Alloyed Steels Under Alternating and Pulsating Stresses," by Professor B. P. Haigh. 8 p.m.

SATURDAY, JANUARY 12TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit (afternoon) to the Deptford West Power Station of the London Power Company, Ltd.

MONDAY, JANUARY 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Recent Developments in the Manufacture of Condenser Tubes," by Mr. A. Spittle. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "Coil Ignition," by Dr. F. W. Lanchester. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Graduates' meeting. "Purchasing," by Mr. E. C. Thompson. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: WESTERN CENTRE.—The Grand Hotel, Bristol. Annual dinner. 6.30 p.m. for 7 p.m.

TUESDAY, JANUARY 15TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Some Aspects of Steam Turbine Development and Application," by Mr. R. Dowson. 7.30 p.m.

WEDNESDAY, JANUARY 16TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Informal meeting. Subject for discussion, "Merits and Demerits of Alternative Methods of Taking Water for Modern Power Stations from Tidal Waters," by Mr. H. H. Dalrymple-Hay. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS: SHEFFIELD AND DISTRICT LOCAL SECTION.—In the Cutlers' Hall, Sheffield. "Early Aviation," by Lieut.-Col. J. T. C. Moore-Brabazon. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Domestic Smoke Problem: A Practical Solution," by Professor C. R. Darling. 8 p.m.

THURSDAY, JANUARY 17TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Engineers' Club, Waterloo-street, Birmingham. "Refractories for Use in Metallurgical Furnaces," by Mr. A. J. Dale. 7 p.m.

FRIDAY, JANUARY 18TH.

JUNIOR INSTITUTION OF ENGINEERS.—At 39, Victoria-street, S.W. 1. Ordinary meeting. "Notes on the Fitting and Operation of Michell Bearings," by Mr. J. Foster Petree. Slides. 7.30 p.m.

SATURDAY, JANUARY 19TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Greenwood's Café, Todmorden-road, Burnley. Annual reunion. 5 p.m.

MONDAY, JANUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Technical College, Glasgow. "Safety in Four-wheel Braking Systems," by Mr. M. Platt. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor lecture. "The Treatment of Coal," by Dr. C. H. Lander. Lecture I. 8 p.m.

TUESDAY, JANUARY 22ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, London, W.C. 2. London Graduates' informal meeting. "The Training of Drivers," by Mr. J. F. Ward. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering and Scientific Club, Queen-street, Wolverhampton. Meeting. 7.30 p.m.

WEDNESDAY, JANUARY 23RD.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Safety in Four-wheel Braking Systems," by Mr. M. Platt. 7 p.m.

MONDAY, JANUARY 28TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "The Treatment of Coal," by Dr. C. H. Lander. Lecture II. 8 p.m.

TUESDAY, JANUARY 29TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "Recent Extensions to Portobello Power Station," by Mr. E. Seddon. 7 p.m.

WEDNESDAY, JANUARY 30TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Shannon Scheme and its Economic Consequences," by Mr. George Fletcher. 8 p.m.

MONDAY, FEBRUARY 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Merchant Venturers' Technical College, Bristol. "Coil Ignition," by Dr. F. W. Lanchester. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "The Treatment of Coal," by Dr. C. H. Lander. Lecture III. 8 p.m.

WEDNESDAY, FEBRUARY 6TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Trueman Wood Lecture. "The Vibrations of Railway Bridges: An Example of Co-operative Research," by Sir J. A. Ewing. 8 p.m.

WEDNESDAY, FEBRUARY 20TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Purification of Water," by Major T. H. Bishop. 8 p.m.

SATURDAY, FEBRUARY 23RD.

INSTITUTE OF BRITISH FOUNDRYMEN.—Grand Hotel, Manchester. Annual dinner.